Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

OCTOBER, 1952

TECHNOLOGY DEPT.

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OCT 2 7 1952
DETROIT

MESTA-THOMSON FLASH WELDERS

..... for increased cold mill production

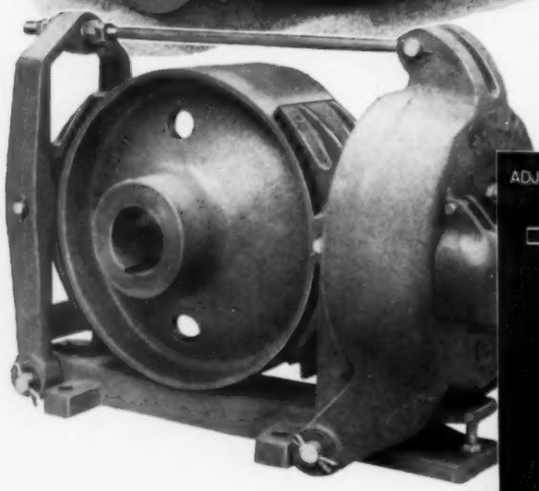
KODACHROME BY E. D. MESTA

Mesta-Thomson Flash Welder installed in a Mesta High-Speed Continuous Pickling Line

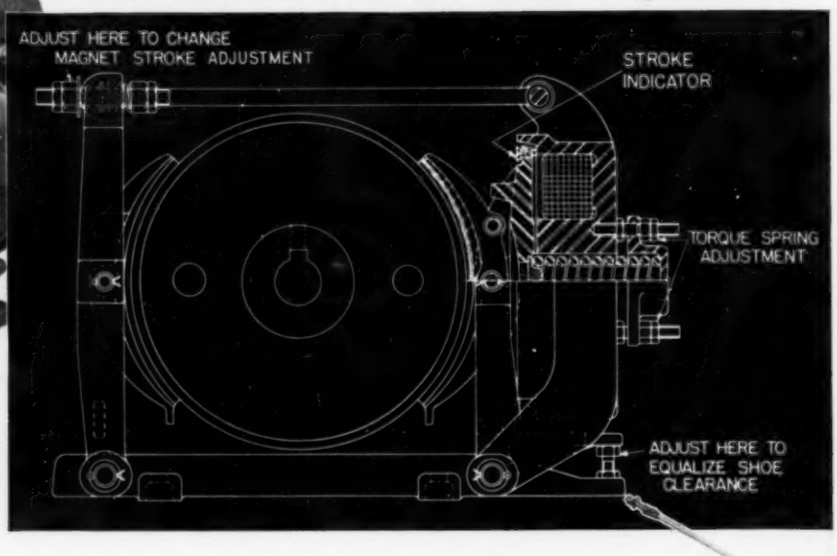
DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS

MESTA MACHINE COMPANY · PITTSBURGH, PA.

Still the Leader!



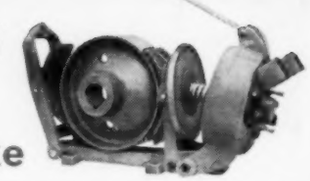
The design of the Type M Brake is so fundamentally correct its performance has never been equalled


ADJUST HERE TO CHANGE MAGNET STROKE ADJUSTMENT
STROKE INDICATOR
TORQUE SPRING ADJUSTMENT
ADJUST HERE TO EQUALIZE SHOE CLEARANCE

Common sense says there *must* be a best way of doing *any* job. It follows as a consequence any method not equal to the best *cannot* produce equal results. There never has been a mill brake as simple in design or as direct in application of braking power as the Cutler-Hammer Type M Brake. And if the popularity of this brake through the years is a criterion, there never has been a brake to equal it in performance.

The action is a direct push of the shoes against the wheel. Since both the field member and armature move in braking and release, action is lightning fast. The simple design eliminates parts that usually cause trouble and need adjustment and repair. Tough lining matched with durable alloy steel wheel reduces lining wear. Take-up adjustments are needed only at long intervals. Many heavy duty installations prove the Type M Brake to have no equal in performance. Write for Publication BR-2 giving full facts on this brake. CUTLER-HAMMER, Inc., 1255 St. Paul Avenue, Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

14 FACTS about Type M Brake



- √ Fundamental design proved by years of service in heavy duty applications
- √ The simplest of all brakes
- √ Has the fewest parts
- √ The brake with the fastest action
- √ The only brake with one-to-one magnet and total shoe stroke
- √ The brake with only 3 simple adjustments
- √ Longest service without take-up adjustments
- √ Tough long-life lining matched with hard Hammerloy steel wheel
- √ Cover-all tubes shield full length of hinge pins against paint, dirt, etc.
- √ Renewable hardened hinge pin bushings
- √ Hard sheet aluminum magnet coil cover plate caulked in place with aluminum wire
- √ Torque spring compression CANNOT be released manually
- √ Torque spring fully protected
- √ Brass friction plugs keep shoes always aligned

All of these features are also provided, when used on A.C. Service with rectifier

CUTLER-HAMMER
MOTOR CONTROL
C-H

It Set the Pattern Years Ago • It has Set the Pace Ever Since

IRON AND STEEL ENGINEER; published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 29, No. 10.

ENGINEERING

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Compagnia Italiana Forme Acciaio, Milano, Italy—Italy.

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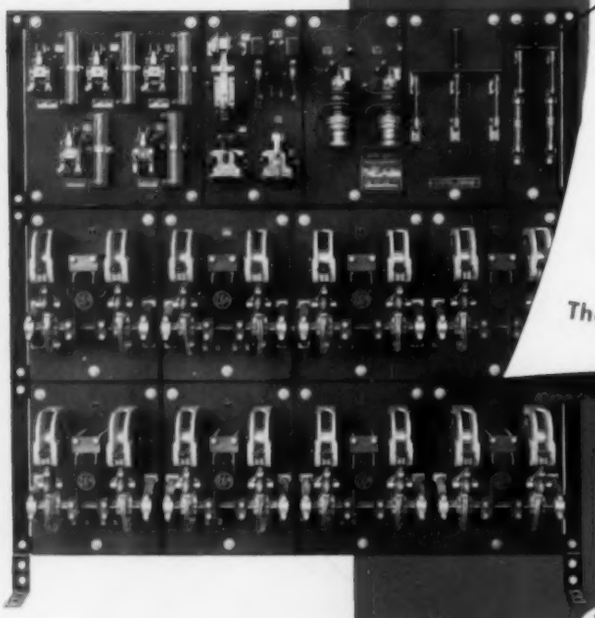
Plants in Warren, Ohio · Ellwood City, P[illegible]vania



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1 LINE-ARC Contactors
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6 TYPE WB Brakes
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9 CONTRA-TORQUE Hoist Control (A-c)
10 TAB-WELD Resistors

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REG. U.S. PAT. OFF.
for A-c Hoists

Better Speed Selection..

Improves OUTPUT

Bucket crane in fertilizer plant.

Magnet gantry crane serving scrap baler installation.

REDUCED torque values for better lowering speeds, suited to the load and ability to start lowering on *any* speed point of the master switch, provide great flexibility, permitting increased production.

Operators are quick to take advantage of the characteristics of EC&M CONTRA-TORQUE Controllers: slow speeds to land a load carefully—using the last point for fast lowering—decelerating the load on intermediate points or using any of these points to release the brake and start down.

Safeguarding the operation at all times are EC&M FREQUENCY RELAYS. If a heavy load speeds up on a weak torque point, these relays automatically switch connections to a strong torque point, checking the motor speed and allowing operation to continue safely.

For bucket and magnet hoists, and similar cranes with permanently loaded hooks, specify EC&M CONTRA-TORQUE Control.

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When you have *Texaco Regal Oil* in the circulating system, your back-up roll necks get the best possible protection against heavy loads and high temperatures. *You* get trouble-free performance, longer bearing life, lower maintenance costs.

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Faithfully yours 50 *for Fifty Years*

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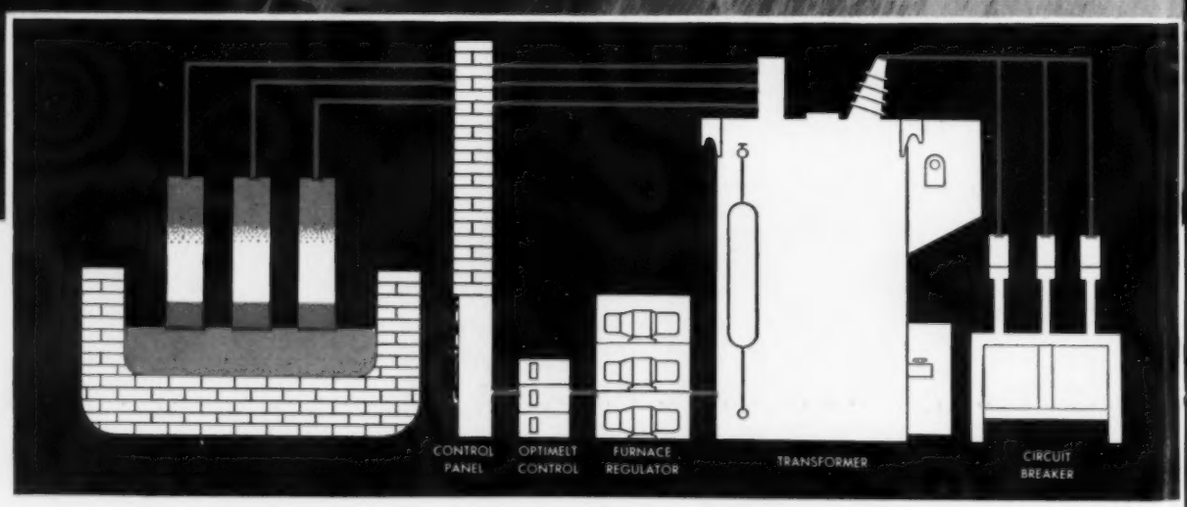

One of steel's toughest electrical problems is solved this way:

Arc furnaces give electrical apparatus one of its toughest assignments. They slam dead shorts across transformers. They rip open circuit breakers 30 to 100 times a day. And they demand ultra reliability because a power failure can be disastrous.

In the midst of violence: precise regulation

Yet in the midst of this violence they also demand *precise electrical regulation* because power is a major cost item and how it is used vitally affects production rates. For these special requirements, Westinghouse has produced special equipment. Today, more Westinghouse furnace equipment is in use than all other makes combined.

Radically designed transformers and breakers

When the furnace electrode touches the charge, a tremendous power surge tries to rip the transformer apart. So Westinghouse supplies its radical *shell-form* transformer which is far stronger than the conventional construction. Similarly Westinghouse supplies special compressed-air circuit breakers which operate seven times longer between maintenance periods than ordinary breakers.

Furnace is regulated by electrical brains

The real trick in running the furnace is maintaining desired power input. Rototrol® does this by watching furnace conditions and continuously adjusting electrode height. But the ultimate refinement is the Westinghouse Optimelt® control which automatically determines the best kw input (according to furnace conditions) and then directs the Rototrol to hold it there.

Call Westinghouse early on EVERY project

This equipment is a good example of the engineering that Westinghouse applies to steel mill problems. When *your* next project comes up, call Westinghouse early in the planning stage.

FREE BOOK ON ARC FURNACES

This 20-page booklet tells how modern Westinghouse equipment can improve your operations and cut costs. Write for B-4695 "Westinghouse Equipment for Arc Furnaces"—Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa.

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EQUIPMENT FOR STEEL PRODUCTION

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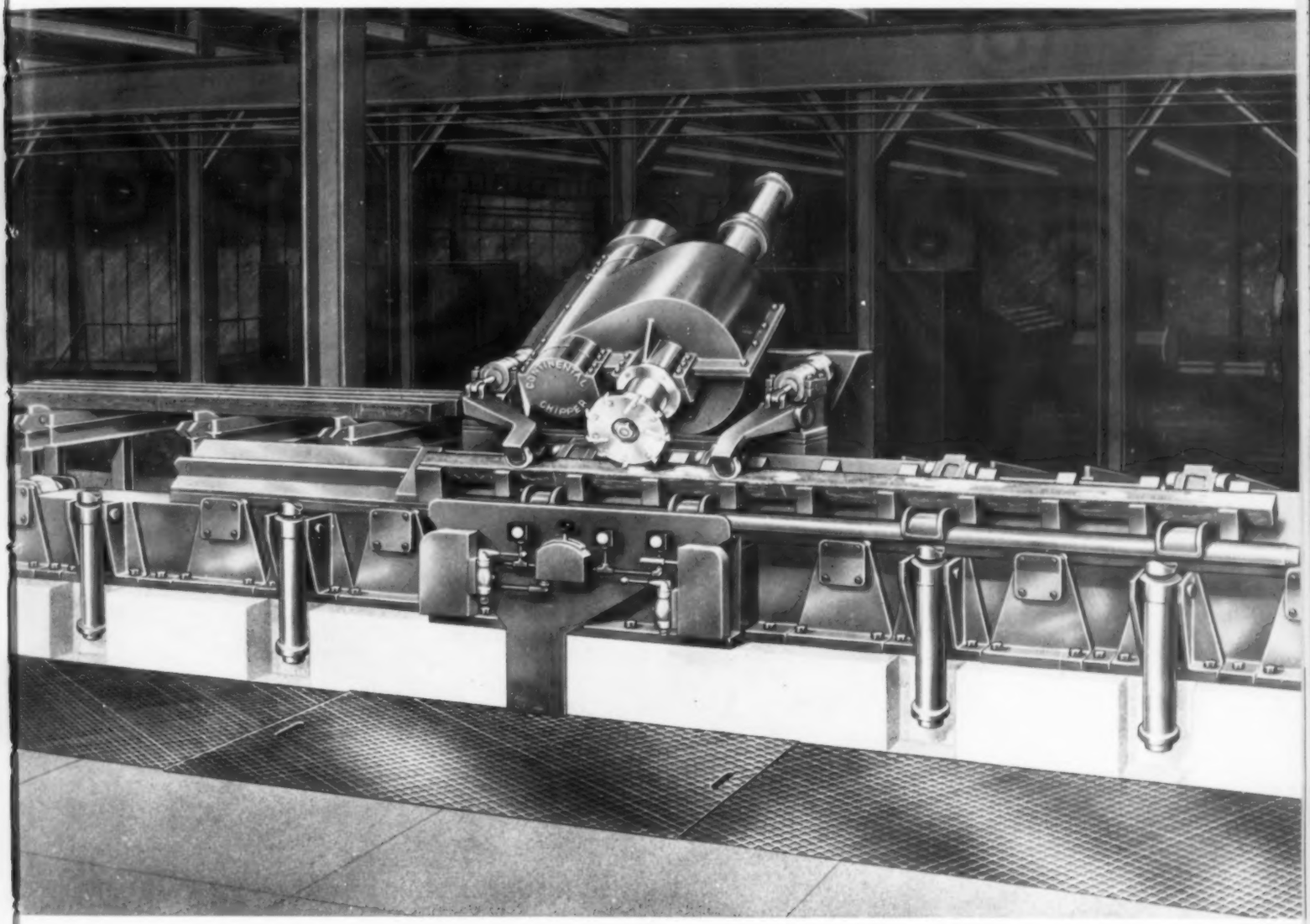

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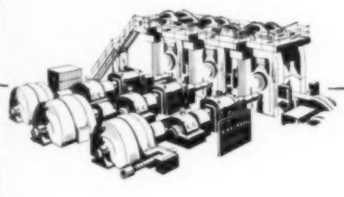

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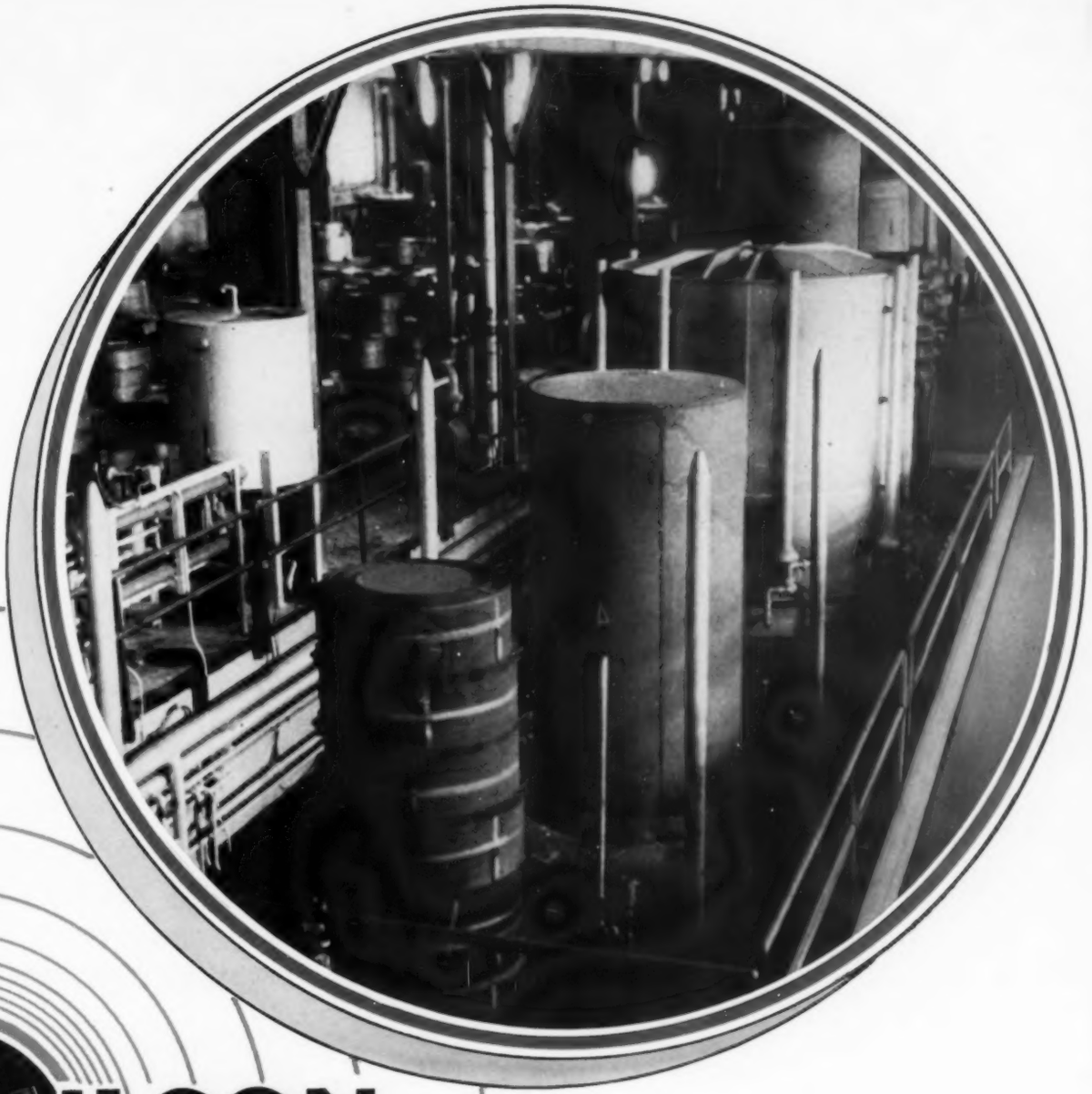

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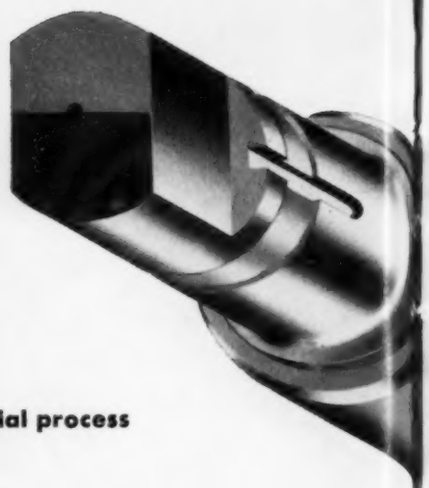

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- Pittsburgh Grade 45
- Pittsburgh Grade 35
- Pittsburgh Grade 25

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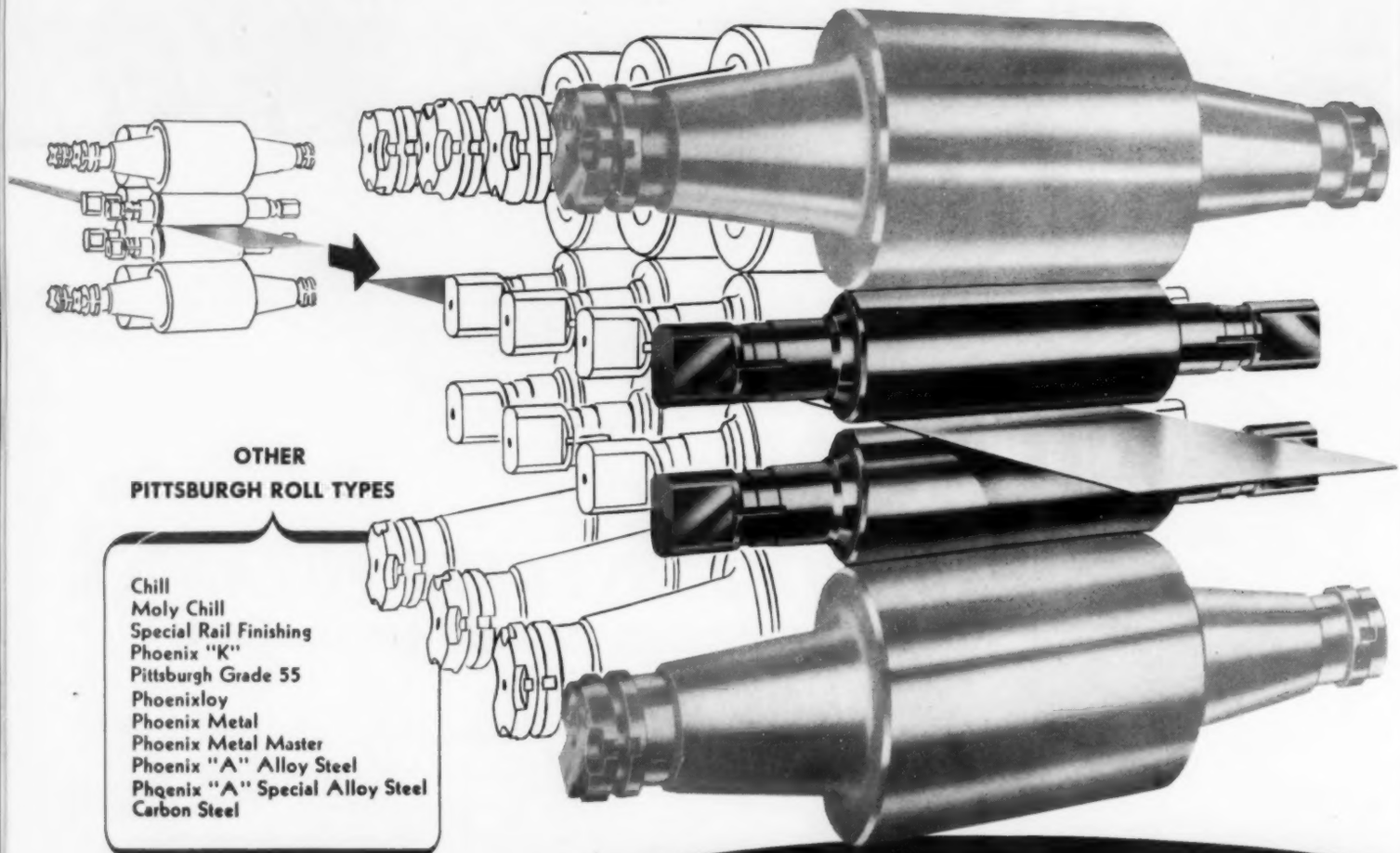

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- Pittsburgh Grade 55
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- Carbon Steel

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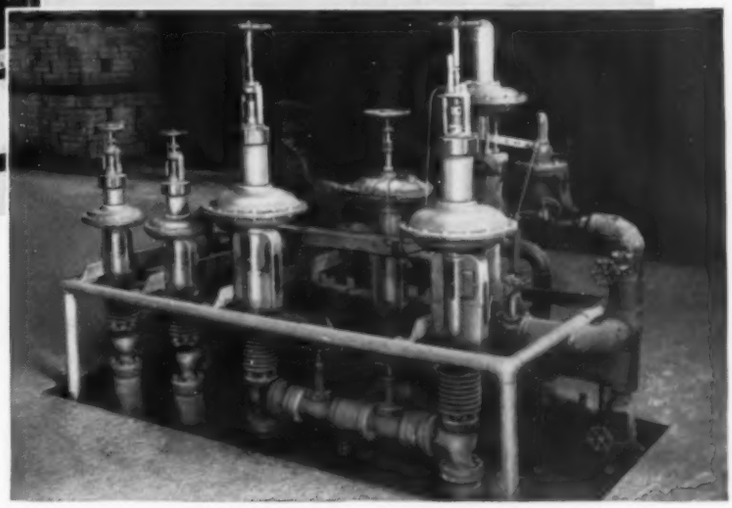
ENGINEERED CONTROL SYSTEMS

for most efficient

OPEN HEARTH OPERATION



Open Hearth Reversal Valve Assembly

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- *Assures the highest available air preheat to furnace.*
- *Maintains balanced checker conditions regardless of temperature level at which checkers are operated.*
- *Increases reversal frequency as temperatures rise toward end of heat.*
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- *Prevents false reversals and increases checker life.*

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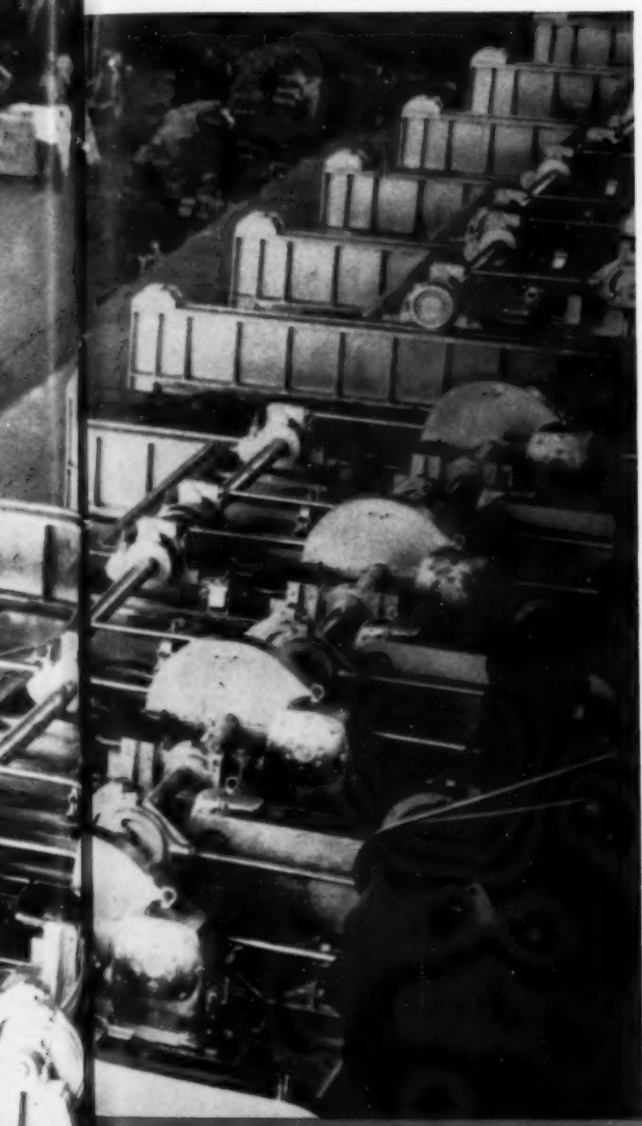
BROWN INSTRUMENTS

First in Controls

*240 Surface

SOAKING PITS SINCE 1948!



The vast majority of soaking pits installed or under construction, in the current steel mill expansion program, have been supplied by Surface Combustion Corporation.

Such an overwhelming preference for 'Surface' pits is the result of proved pit dependability and such engineering advancements as the new venturi jet pump recuperative system.

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● Equipment produced by Surface Combustion, the originator of the one-way fired soaking pit in this country, has been compiling for many years unmatched records for production, dependability and maintenance economy in America's steel mills.

Surface A GREAT PRODUCTION NAME IN THE STEEL INDUSTRY

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

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Successful pouring of a roll is the most important factor in its successful performance . . . that's why National's metallurgical knowledge and practical experience are so important, too, right from the start.

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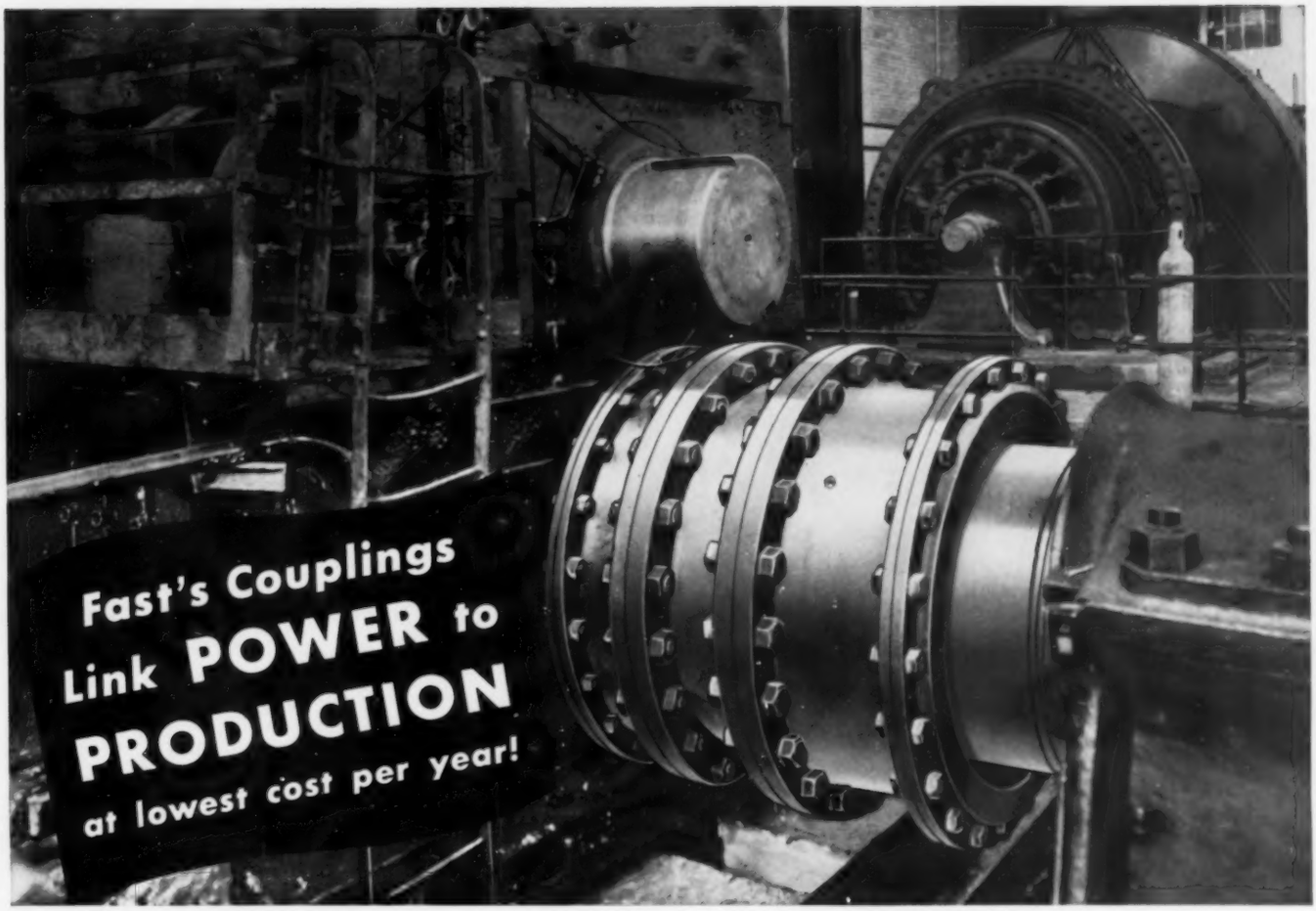
SPECIALISTS IN
IRON AND ALLOY IRON ROLLS AND CASTINGS



FAST'S Couplings usually outlast the equipment they connect!

ACTUAL cases on record show many Fast's Couplings are still in service after as much as 30 years of continuous operation! Time and time again, equipment has been replaced while the original Fast's Couplings remained on the job.

To you, these records of dependable, trouble-free service mean freedom from costly coupling failures when you specify Fast's. And they mean Fast's cost you far less to own and operate . . . because their cost can be amortized over long years of dependable performance.

For full details on how Fast's Couplings and Koppers Engineering Service can help you, write today for a free copy of our catalog to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 310 Scott St., Baltimore 3, Maryland.

Here's How FAST'S Save You Money

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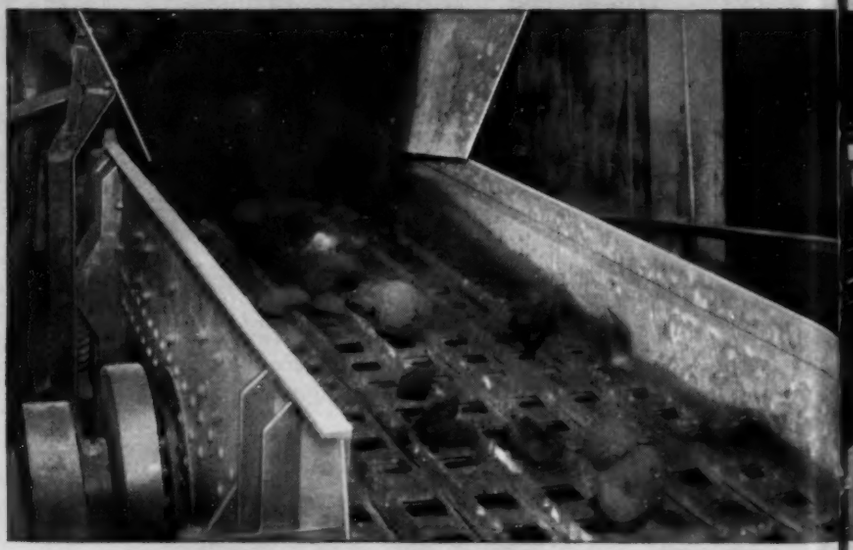
WORLD'S LARGEST CRUSHERS are two 3500-tph, 60-109 *Superior* gyratories being built for Mesabi's first commercial taconite plant. Ultimate plant output will be 10 million tons.



FINES ARE SCALPED from r.o.m. ore on sturdy 1000-tph vibrating screens like this one in Minnesota. A-C builds *six* separate types of vibrating screens for beneficiation.

EQUIPMENT FOR IRON ORE BENEFICIATION: Gyratory and jaw crushers . . . Vibrating screens . . . All types of washers . . . Concentrating jigs . . . Rod, ball, and *Ballpeb* mills . . . Centrifugal pumps . . . Rotary kilns and coolers . . . *Texrope* V-belt drives . . . All types and sizes of electric motors and generators . . . Starters . . . Transformers and voltage regulators . . . Complete power generation, distribution, control equipment.

the Bottom!

As Mesabi Ores Lean Out, Allis-Chalmers Aids in Beneficiation

DIRECT SHIPPING ORES are fading fast up on the once fabulous Mesabi range. But despite foreign ore discoveries, by 1955 a quarter of blast furnace feed must be beneficiated domestic ore.

Allis-Chalmers — manufacturer of equipment for the steel industry from the mine to the mill — is helping lead the way to more economical beneficiation of lean ores.

Does low ore content require you to triple material handled? Allis-Chalmers will build you bigger, more efficient equipment! At far left below is the world's largest crusher, being built by A-C for a Mesabi taconite plant.

Has proper yet economical pelletizing got you stumped? Allis-Chalmers has just put into operation a pilot Pelletizing and Heat Hardening plant built exclusively for researching new pelletizing methods.

Do you have a beneficiation "shortcut" in mind? Don't let lack of equipment postpone your testing of new processes. The Allis-Chalmers Processing Research Laboratory stands ready to accurately and exhaustively test any processing method on a confidential basis.

For over half a century Allis-Chalmers equipment has been processing ores for America's steel industry. Some of the cost-cutting, tonnage-increasing ore beneficiation equipment in the broad A-C line is seen on these pages.

Allis-Chalmers offers you *one-manufacturer responsibility* for process, drive and control equipment all along your flow sheet. For literature or detailed information on products and services, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3808

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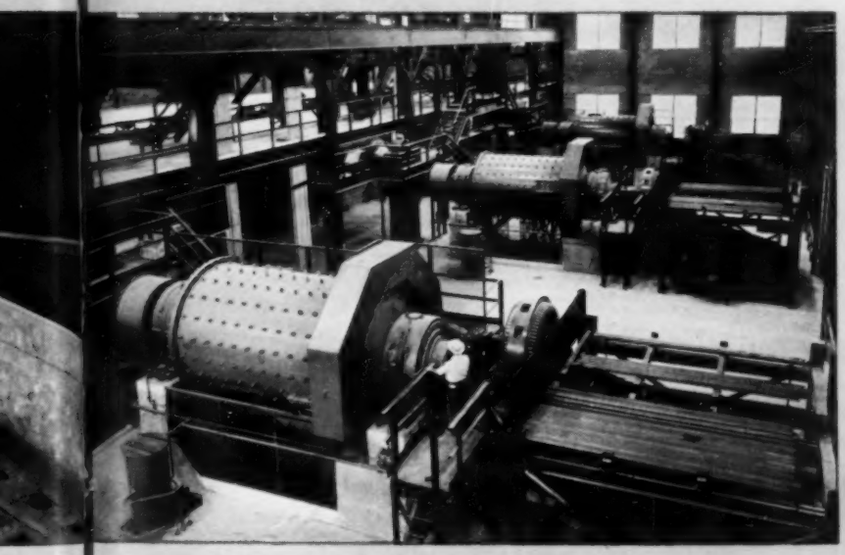
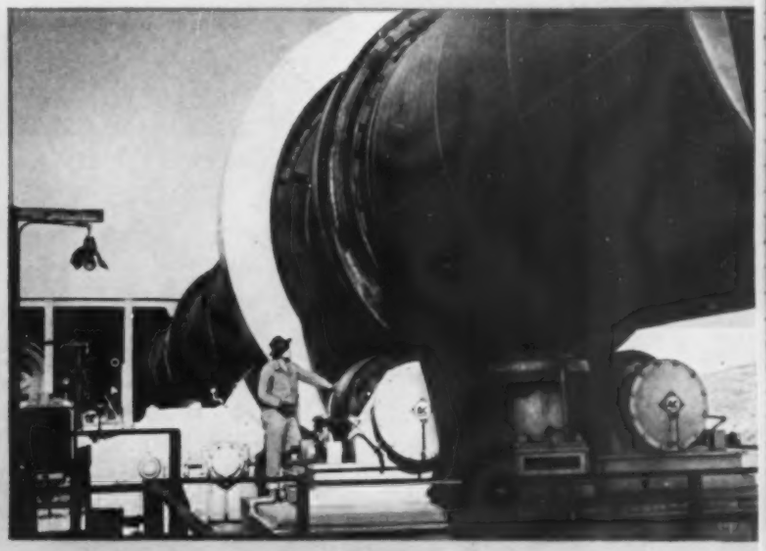


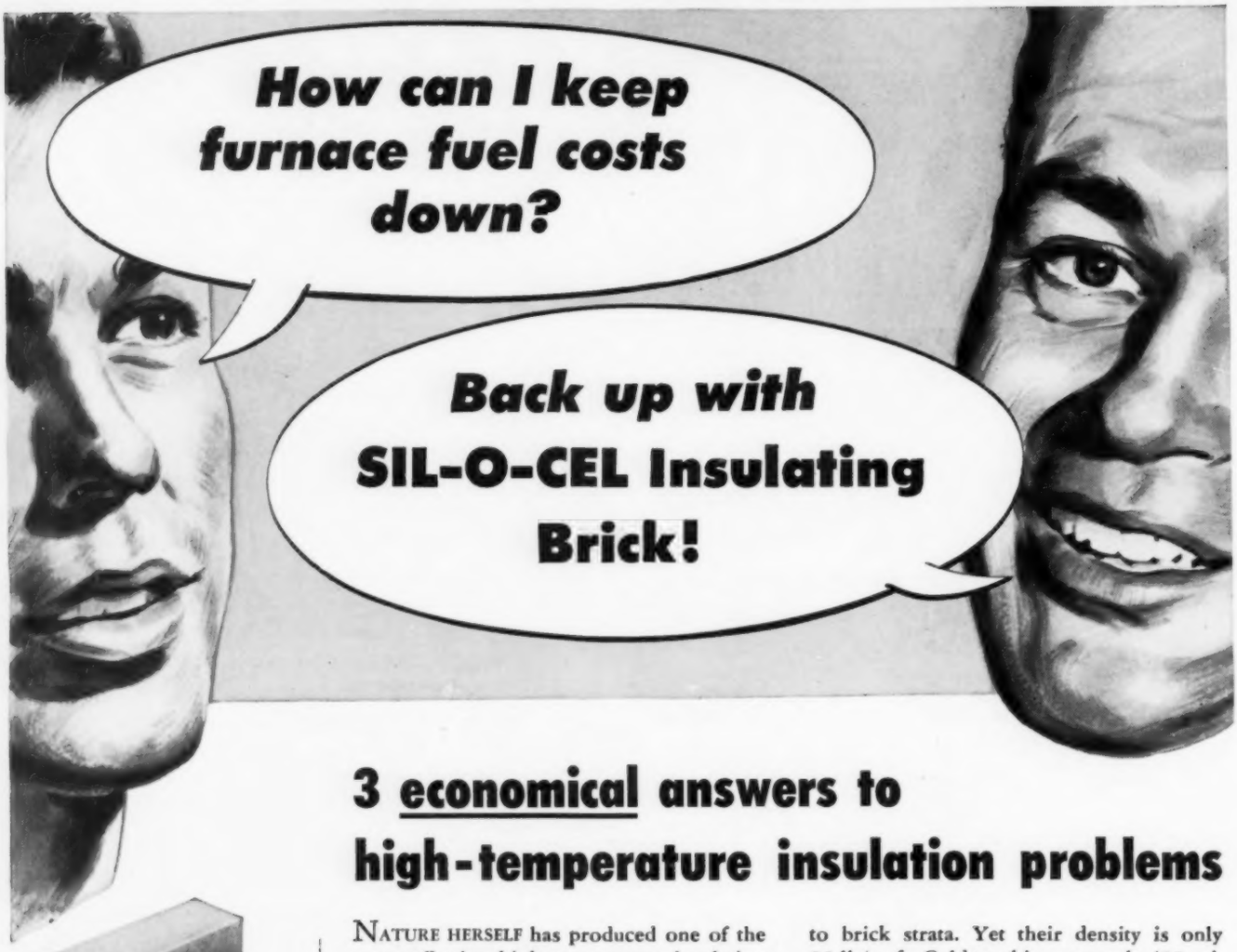
ORE IS GROUND in three rod and ball mills ahead of magnetic separation at this beneficiation plant. A-C builds *all* types of grinding mills for ore beneficiation processes.



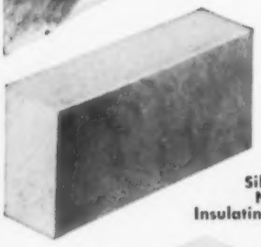
IRON ORE IS AGGLOMERATED to make good blast furnace and open hearth feed in Allis-Chalmers rotary kilns in connection with iron mines and beneficiation plants.

ALLIS-CHALMERS

Power, Electrical, Processing Equipment for Iron and Steel

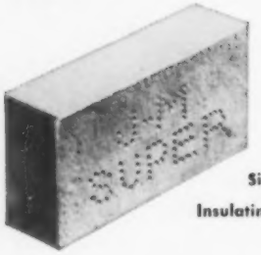


3 economical answers to high-temperature insulation problems



Sil-O-Cel Natural Insulating Brick

Sil-O-Cel C-22 Insulating Brick



Sil-O-Cel Super Insulating Brick

NATURE HERSELF has produced one of the most effective high-temperature insulating materials ever discovered—diatomaceous silica, from which Sil-O-Cel® Insulating Brick are made.

These insulating brick are used for back-up insulation behind fire brick or insulating fire brick linings in boilers, stills, stacks, heat-treating furnaces, kilns, lehrs, flues, retorts, and other types of high-temperature equipment.

Sil-O-Cel Insulating Brick have excellent insulating qualities combined with high load-bearing characteristics and light weight.

Made in all standard shapes of the 2½ in. and 3 in. series, Sil-O-Cel Insulating Brick are produced in three basic types:

SIL-O-CEL NATURAL INSULATING BRICK
for temperatures to 1600F

Quarried directly from one of the world's purest deposits of diatomaceous silica, these insulating brick have a conductivity of only 0.79 Btu in./sq ft/F/hr at 1000F mean temperature, with heat flow perpendicular to brick strata. Yet their density is only 30 lb/cu ft. Cold crushing strength, 400 psi.

SIL-O-CEL C-22 INSULATING BRICK
for temperatures to 2000F

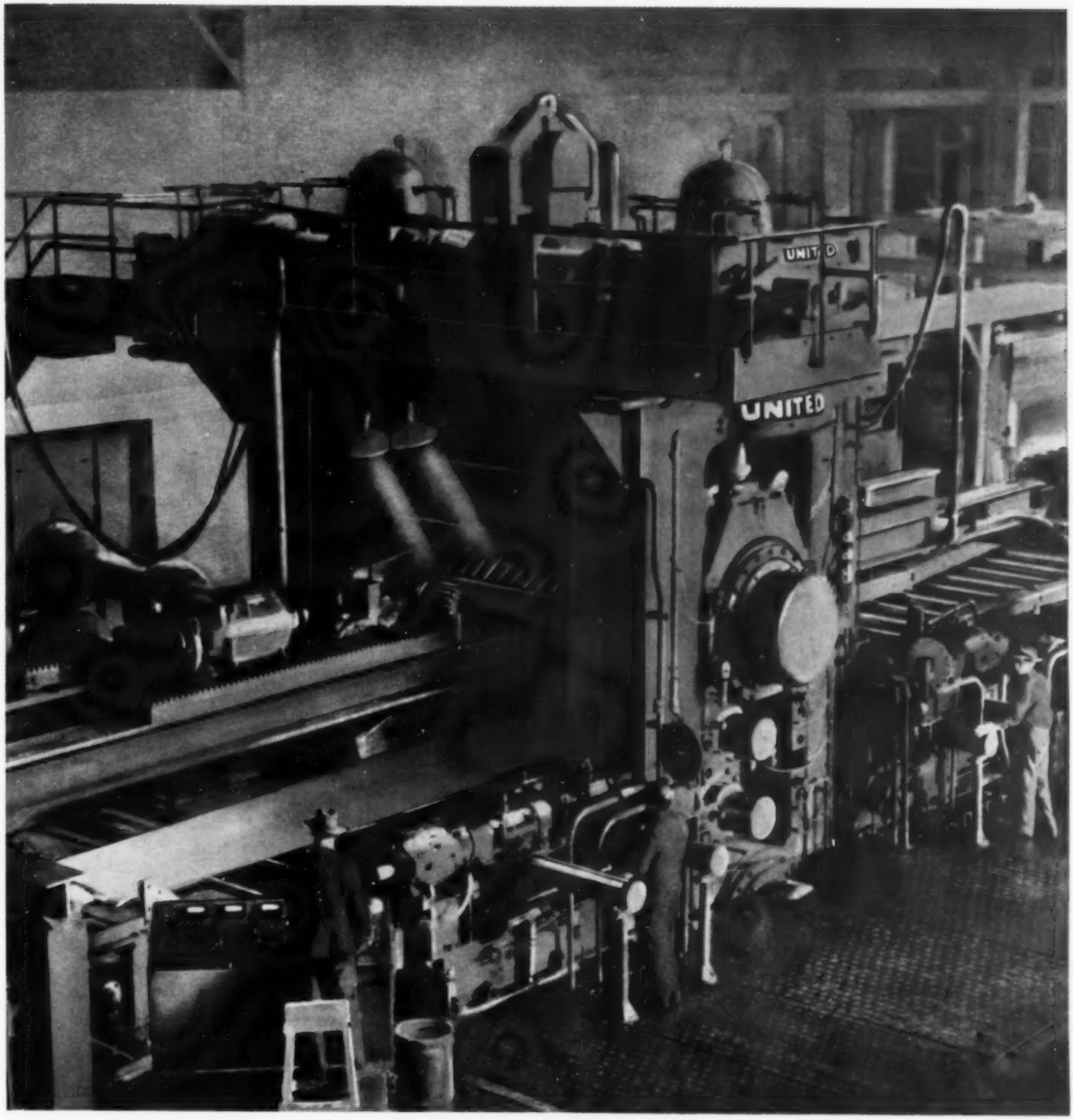
Ideal where high load-bearing properties are needed, this type of Sil-O-Cel is calcined, and has a cold crushing strength of 700 psi. Conductivity is 1.88 Btu in./sq ft/F/hr at 1000F mean temperature. Density, 38 lb/cu ft.

SIL-O-CEL SUPER INSULATING BRICK
for temperatures to 2500F

A calcined insulating brick for unusually high temperatures. In many cases, it is also possible to save on construction costs by reducing the thickness of fire brick or insulating fire brick when backed with Sil-O-Cel Super Insulating Brick. Conductivity is 1.95 Btu in./sq ft/F/hr at 1000F mean temperature. Density, 40 lb./cu. ft. Cold crushing strength, 300 psi.

For further information, write to Johns-Manville, Box 60, New York, N. Y. In Canada, write 199 Bay St., Toronto 1, Ont.

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville** *first in* **INSULATIONS**



4 High Aluminum Rolling Mill

Designed and Built by

UNITED ENGINEERING and FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at PITTSBURGH • VANDERGRIFT • NEW CASTLE • YOUNGSTOWN • CANTON

Subsidiaries: Adamson United Company, Akron, Ohio
Lewis Foundry and Machine Co., Inc., Aurora, Indiana

Designers and Builders of Ferrous and Nonferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other Heavy Machinery, Manufacturers of Iron, Nodular Iron and Steel Castings, and Weldments

which one?

There are a lot of conflicting claims about which type of anti-friction bearing is best. Actually, each type has its advantages. The problem is to decide which is best for the job at hand.

Torrington makes every basic type of anti-friction bearing. Our engineers know the relative advantages of each and have accumulated a fund of experience in their applications. Leading builders and users of mechanical equipment have learned to rely on Torrington for impartial recommendations.

Next time *you* are selecting anti-friction bearings, let us know. We will be glad to work with you.

THE TORRINGTON COMPANY
South Bend 21, Ind. Torrington, Conn.
District Offices and Distributors in Principal Cities of the United States and Canada

TORRINGTON BEARINGS

Spherical Roller • Tapered Roller • Straight Roller • Needle • Ball • Needle Rollers

What's the $ Connection?

If there's a furnace operation in your setup . . . there's a mighty big connection between the CITIES SERVICE HEAT PROVER and your profit and loss picture.

Heat Prover—not an instrument you buy, but a service we supply—helps to increase furnace productivity through these five unique advantages:

1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

ACCURATE, FAST CITIES SERVICE HEAT PROVER ANALYSIS CAN PUT THE FINGER ON WASTE IN YOUR FURNACE OPERATION. It's being widely used in a great variety of industries. Find out how Heat Prover can serve you. Write Cities Service Oil Company, Dept. J17, Sixty Wall Tower, New York City 5.

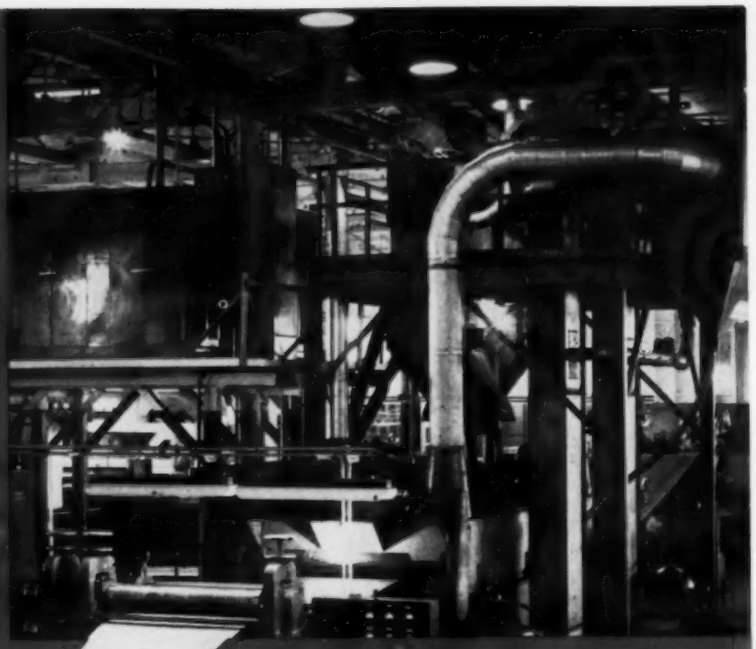
CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

WHEELABRATOR®

Mechanical Cleaning

descales steel strip



. . . cheaper than pickling

saves valuable floor space

at Rome Cable Corporation

The economies and high speed production of the airless Wheelabrator method of mechanical descaling of hot rolled steel strip are reflected in this typical installation in the Torrance, California plant of the Rome Cable Corporation, manufacturers of electric weld heavy wall conduit.

The airless Wheelabrator method was selected by Rome Cable Corp. because it was the only process that would economically remove surface scale and permit the rest of the plant to maintain its high production without consuming a major portion of the plant area. Whereas approximately 175 lineal feet of floor space would be required for acid pickling, the Wheelabrator cabinet takes up only 25 lineal feet.

The steel strip is descaled prior to slitting for less than the cost of acid pickling. Another important saving is realized in the fact that the Wheelabrator removes scale only . . . there is no loss of virgin metal.

Wherever steel is processed in large quantities, the possibilities for saving money with a Wheelabrator are tremendous. We would be glad to demonstrate these savings for you. Write today for full details.

WHEELABRATOR — The perfected airless centrifugal blast unit pioneered by American scours away scale and dirt mechanically at low cost. Provides a more uniform etch for mill rolls, effects unusual economies in cleaning strip, sheet, bar stock and skelp.

American

WHEELABRATOR & EQUIPMENT CORP.

396 S. Byrkit St., Mishawaka, Indiana

WORLD'S LARGEST BUILDERS OF AIRLESS BLAST CLEANING EQUIPMENT

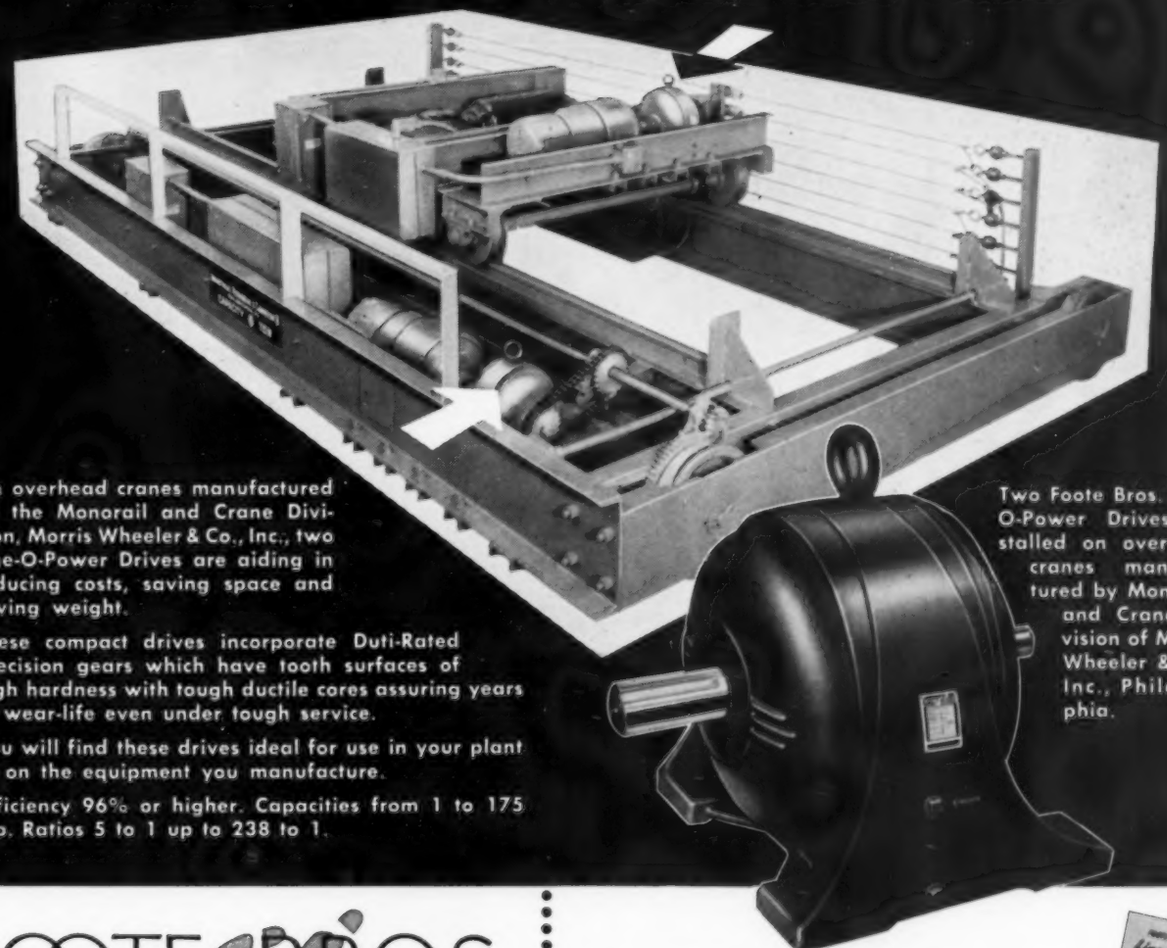
HOW MORRIS, WHEELER & CO., INC.

CUT Original Cost

CUT Operating Cost

SAVED SPACE • SAVED WEIGHT

with FOOTE BROS. Line-O-Power Drives



On overhead cranes manufactured by the Monorail and Crane Division, Morris Wheeler & Co., Inc., two Line-O-Power Drives are aiding in reducing costs, saving space and saving weight.

These compact drives incorporate Duti-Rated precision gears which have tooth surfaces of high hardness with tough ductile cores assuring years of wear-life even under tough service.

You will find these drives ideal for use in your plant or on the equipment you manufacture.

Efficiency 96% or higher. Capacities from 1 to 175 h.p. Ratios 5 to 1 up to 238 to 1.

Two Foote Bros. Line-O-Power Drives installed on overhead cranes manufactured by Monorail and Crane Division of Morris Wheeler & Co., Inc., Philadelphia.

FOOTE BROS.

Better Power Transmission Through Better Gears

Maxi-Power Drives

Hygrade Drives

Foote Bros.-Louis Allis Gearmotors

Foote Bros. Gear and Machine Corporation
Dept. IAS, 4545 South Western Boulevard
Chicago 9, Illinois

Please send me a copy of Bulletin LPB on Foote Bros. Line-O-Power Drives.

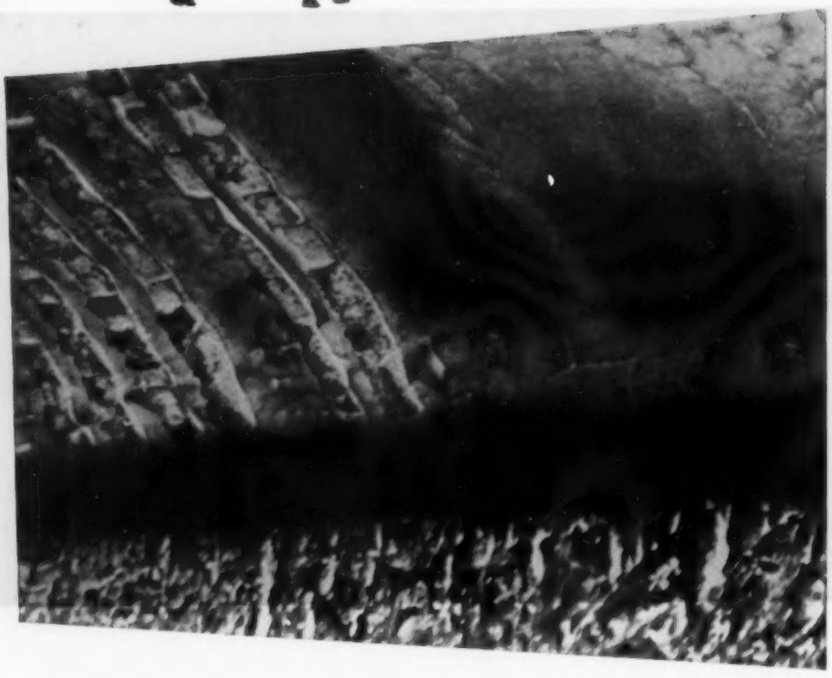
Name.....

Company.....

Position.....

Address.....

City.....Zone.....State.....



Revolutionary

"ZEBRA ROOFS", built with alternate rings of silica brick and patented STEELKLAD-40 give top performance when open hearths are pushed for peak production. Unretouched photo shows marked superiority of ZEBRA section (on the left) over surrounding silica brick. Many operators report increased roof life despite higher tonnage. Others find reduced repairs to roof and backwalls. More and more plants are standardizing on ZEBRA roofs. Best results are obtained with 3″ Silica Keys alternated with 3″ or 6″ of STEELKLAD-40.

A Complete Refractories Service

GREFCO BASIC BRICK For All Industry

The metallurgical industry demanded furnace linings capable of withstanding extremely high temperatures under extraordinary operating conditions. To meet this challenge, Grefco research produced the famous RITEX unburned basic brick—one of the outstanding advances in the entire history of brick manufacture. RITEX brick possess great accuracy to specified dimensions. They are more resistant to thermal spalling ... offer lower porosity, lower thermal conductivity, and higher hot strength. These properties insure increased service at reduced cost.

STEELKLAD For Tough Duty

For service too tough even for RITEX, Grefco offers STEELKLAD, an unburned basic brick, permanently jacketed in a patented steel shell. The brick will not slide from its shell in the construction of a furnace wall. When the furnace is heated the steel oxidizes and is absorbed by the brick. It provides an exceptionally efficient monolithic lining that outlasts all other brick in basic open-hearth steel furnaces, electric-arc furnaces, soaking pits, copper smelting and refining furnaces, and other basic metallurgical furnaces.

Take A Look At STEELKLAD

Shown at the left is a typical STEELKLAD basic brick, steel-jacketed on the four major faces, and containing Grefco's unburned magnesite-chrome brick. The brick itself is exclusive and patented—as is the permanent steel shell. It may mean major savings in your operation.

Child's Play... *made with brick!*

• Skating down the sidewalk ... thanks to bearings made with brick. Tiny steel bearings, little brothers to the precision-ground bearings that help move the wheels and shafts of American industry.

The production of steel for bearings—chemicals, glass, metals, for most everything else we use—depends largely on refractories to contain the high temperatures necessary in the furnaces of industry. Such products as Grefco silica brick, a favorite in electrical-steel and open-hearth furnaces, and in coke ovens.

General Refractories Company is one of the two largest producers of silica brick in the world.

Grefco silica brick are available in ever-increasing supply to meet the demands of American enterprise. And, like the thousands of other refractories products made by Grefco, they are the subject of constant research to assure their top quality.

If there's a smokestack in your business—call on the *complete refractories service* offered by Grefco.

GENERAL REFRACTORIES COMPANY

PHILADELPHIA

PRODUCING AGAIN...
13 HOURS SAVED

Powder-lancing pierces

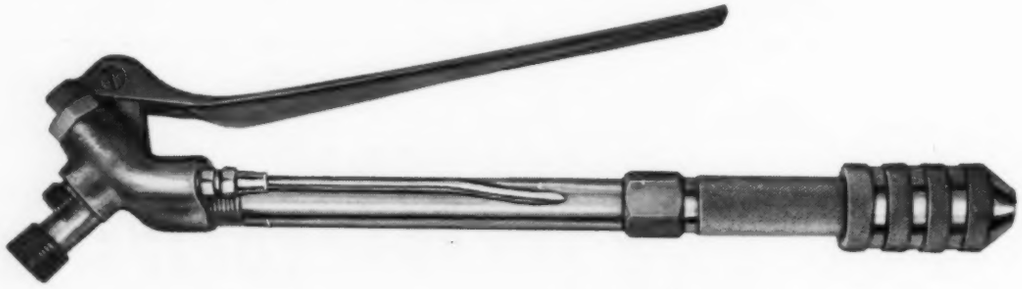
blast-furnace salamander in only **½ hour**

That's just one case. Other steel mills have gone back into production just as quickly—thanks to the efficient use of powder-lancing.

Powder-lancing is a new idea for increasing the efficiency of oxygen lance operations. By introducing powder into the oxygen stream, an exothermic reaction results producing extremely high temperatures. Holes are easily pierced not only in salamanders, but in concrete, cinder block, fire brick, aluminum, and other materials at speeds up to 11 in. per minute. And lance pipe needs no threading. A twist seals it into the holder.

LINDE's ACL-1 Powder Lance automatically adds to the oxygen stream the correct amount of powder for best results. For further details, telephone or write today. LINDE AIR PRODUCTS COMPANY, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: Dominion Oxygen Company, Limited, Toronto.

LINDE's ACL-1 Powder Lance can be used with any standard pipe.



LOOK TO *Linde* Trade-Mark **know-how . . . show-how . . . products and processes FOR WELDING, CUTTING, TREATING, FORMING METALS**

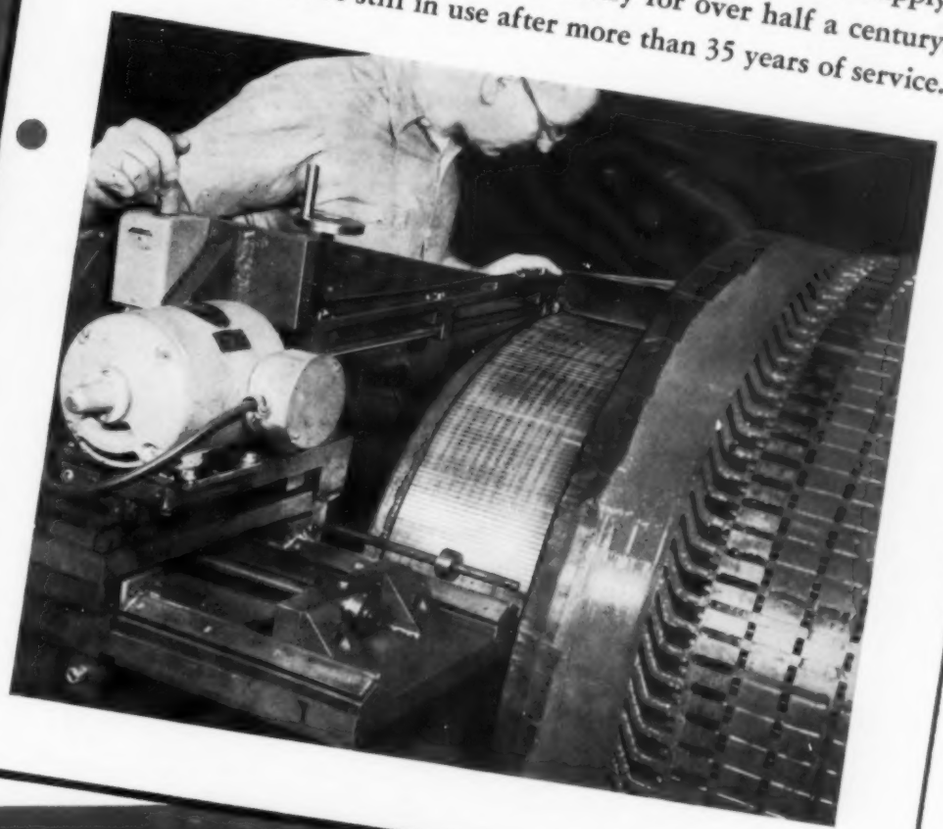
The term "Linde" is a registered trade-mark of Union Carbide and Carbon Corporation.

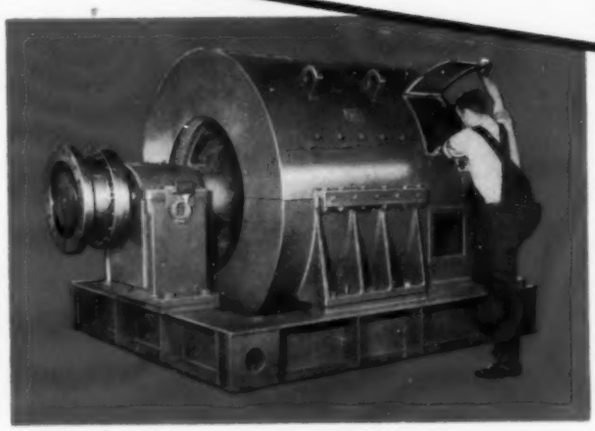
ANOTHER* EXAMPLE OF ELLIOTT Excellence IN MOTORS

*Precision Workmanship

in the careful undercutting of commutator mica segments, is characteristic of the painstaking attention to detail which insures dependable performance in Elliott large direct-current motors.

This extreme care in all stages of design and manufacture, is traditional with Elliott motors. Elliott shops have been supplying direct current machines to industry for over half a century. Some of them are still in use after more than 35 years of service.





The Elliott Mill Type DC Motor shown at left is rated 1000 hp, 200/400 rpm, 600 volts, with force ventilation covers including removable hinged doors of clear plastic for ready inspection and maintenance of commutator and brushes. This motor is driving a reversing cold strip mill.

ELLIOTT Company

DEPT. IS

Ridgway Division

RIDGWAY, PA.

R2-7

For motors 1—200 HP: Crocker-Wheeler Div., Ampere, N. J.

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

Alliance 12-ton

OPEN HEARTH CHARGING MACHINE

● This photograph shows a new low-type 12-ton Alliance Charging Machine recently installed in one of the world's largest and most efficient steel producing plants.

This machine, designed and built by Alliance, world's largest builder of big cranes, has an unusually large number of exclusive new features that make charging operations easier and less costly.

For instance there's a —

Spring-loaded pitman that always keeps the trolley on the rails, providing ample traction for pushing scrap into the furnace and for the retraction of peel and box.

Box section bridge girder made of welded I-beams reinforced by diaphragms spaced at 3-ft. intervals.

Full length machinery deck plate located between the main and outrigger girders provides lateral stiffness and a safety platform for maintenance.

Stabilized, shock-absorbing wheels are held in contact with both upper and lower rails by means of springs, which reduces shock to the operator.

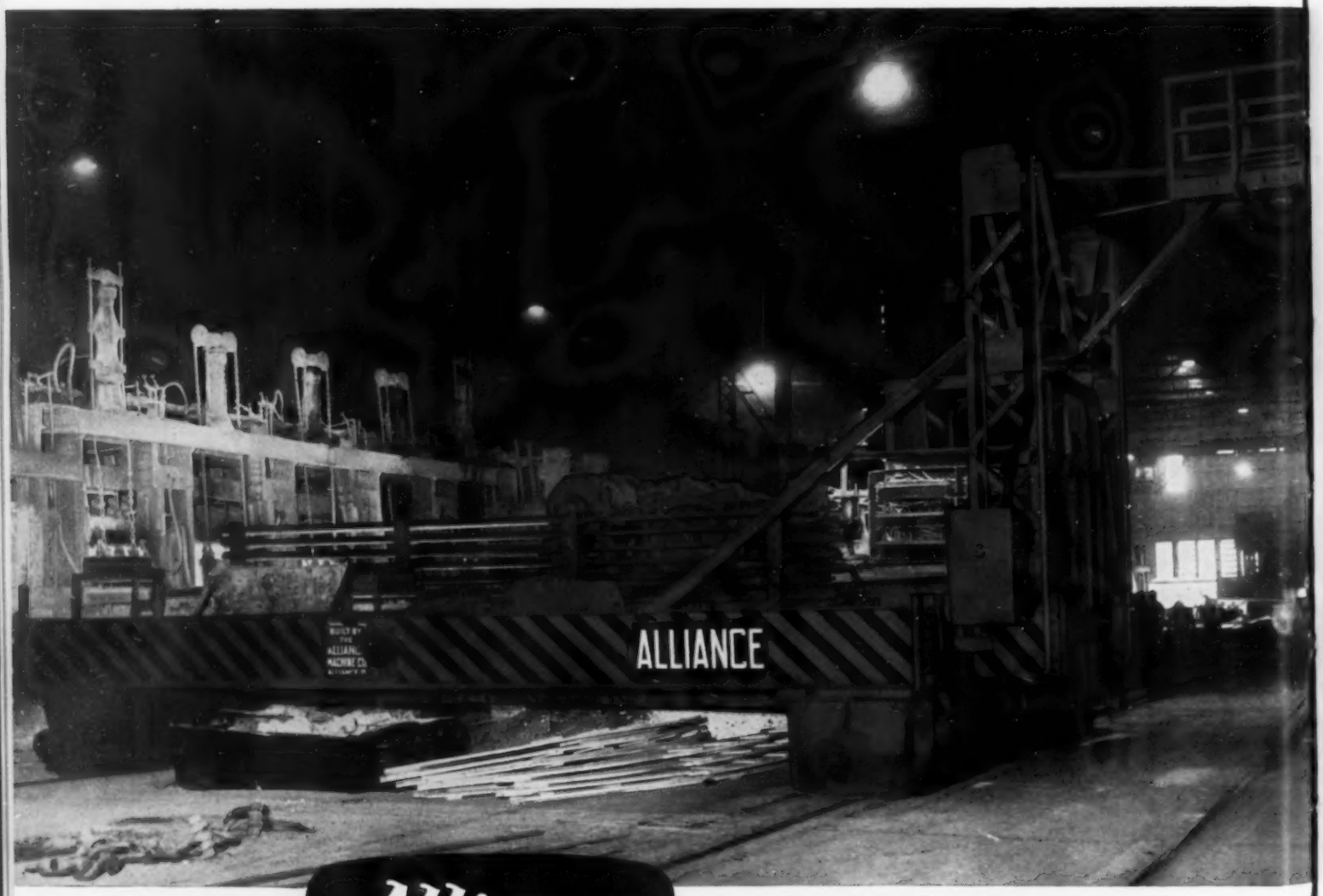
Four track-equalizer trucks, located at the corners on eight-wheel bridges, compensate for any irregularities in the track.

Finger-tip control provided by new type hydraulic lock rod.

All gears (including track wheel gears) are fully enclosed and run in oil.

These and many other Alliance features result in smoother overall plant operation.

Whenever it's a problem of handling heavy materials of any kind at your plant, contact Alliance . . . the world's most respected builder of big cranes.



THE Alliance MACHINE COMPANY

World's largest builders of world's largest cranes

MAIN OFFICE
ALLIANCE, OHIO • PITTSBURGH OFFICE **1622 OLIVER BUILDING, PITTSBURGH, PA.**

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

AMERICAN CHEMICAL PAINT COMPANY

AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet

Subject: IMPROVED DRAWING AND COLD FORMING WITH GRANODRAW

INTRODUCTION:

When steel is phosphate coated with "Granodraw" prior to working it, drawing, extrusion, and other cold forming operations are greatly improved. In fact, the protective phosphate coating makes the cold extrusion of steel possible.

Getting cold steel to flow depends on the unique properties of this coating. Its non-metallic phosphate crystals are physically and chemically adapted to acquire a strongly adsorbed lubricant. The combination of adherent phosphate coating and adsorbed lubricating film possesses a low coefficient of friction while maintaining its integrity under extremely high deforming pressures.

"GRANODRAW" DATA

"Granodraw" zinc phosphate coating chemical is applied to pickled surfaces in an immersion or spray process. When used with a suitable lubricant, the coating reduces friction under conditions of low, medium, or high deforming forces encountered in such typical operations as: cold extrusion of steel; cold shaping; deep drawing (tubs, cartridge cases, shells, etc.); stamping; drawing of wire and tubing; ironing; necking; nosing; and upsetting.

TYPICAL APPLICATIONS

WIRE. "Granodraw"-coated fine wire to be wet drawn, is given an 85% to 95% reduction in cross-sectional area at 15% to 25% greater drawing speed. In addition, the appearance and profile of the drawn wire show considerable improvement over uncoated wire drawn with conventional lubricants. One interesting advantage in the use of the phosphate coating is the corrosion resistance imparted to the drawn wire by residual coating adhering to the steel after as many as 13 holes. Loss of such wire because of corrosion during storage has been practically eliminated.

TUBING. A tube mill is accomplishing a 40% reduction and a mirror-like inside surface with the aid of "Granodraw" coatings. The speed of this draw is over 100 feet per minute and the die life is considerably longer than when no phosphate coating is used.

PLATED WORK. Articles to be plated after forming may now be polished in the flat, formed on the presses, and sent to the plating line with no further polishing. The application of a "Granodraw" phosphate coating and lubricant protects the polished surface during press operations, preventing scratches and gall marks from appearing. Since contour polishing and hand buffing are very expensive, their elimination by the use of "Granodraw" provides considerable savings.

The drawing of wire and many other cold forming operations — including the cold extrusion of steel — are greatly facilitated by the application of a "Granodraw" phosphate coating and a suitable lubricant prior to working.

TYPICAL APPLICATIONS (Cont'd)

CARTRIDGE CASES. The phosphated, lubricated cup for a large cartridge case is given an 80% reduction in four passes with no intermediate anneals or surface treatments. Finish is excellent and the total life extended considerably over components formed without the use of the phosphate coating. In another case, a cup for a shell is phosphated and lubricated and given a 67% reduction with one pass through two dies.

ADVANTAGES OF PHOSPHATE COATING WITH "GRANODRAW" PRIOR TO COLD FORMING STEEL

The following are among the advantages indicated for phosphate coating with "Granodraw" prior to cold forming steel:

Drawing of wire, bars, tubing, etc.—Improved lubrication; improved surface; less scratching; reduced pull; greater percent reduction per pass; reduced die wear; longer die life; lower die maintenance and cost; reduction in corrosion.

Drawing of stampings, shells, shell cases, etc.— Improved lubrication; reduced breakage; reduction in scrap; deeper draws; less scratching; elimination of some annealing; less wear on dies.

Cold Extrusion— Improved lubrication; increased strength of parts; improved surface; reduction in load on press; greater dimensional accuracy; more uniform wall thickness; longer extrusions; elimination of some annealing; less corrosion.

CHEMICALS ACP PROCESSES

WRITE FOR FURTHER INFORMATION ON "GRANODRAW" AND ON YOUR OWN METAL PROTECTION PROBLEMS.

CHEMICALS ACP PROCESSES

When you specify

HAGAN RING BALANCE FLOW METERS

you are buying

★ DEPENDABILITY
★ VERSATILITY
★ ACCURACY

features of HAGAN RING BALANCE METERS include:

- No stuffing boxes or pressure-tight bearings
- Excellent response at extremely low flow rates
- Mercury level not critical
- Ease of dead-weight calibration

Hagan Ring Balance Meters are simple in design, rugged in construction. Whatever your metering problems, our engineers are at your service. For full information, get in touch with

HAGAN CORPORATION

HAGAN BUILDING

PITTSBURGH 30, PENNSYLVANIA

HAGAN
HALL
BUROMIN
CALGON

Hagan Corporation
Hagan Building • Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters.

I am particularly interested in .....

.....

NAME .....

POSITION .....

COMPANY .....

STREET AND NUMBER .....

CITY ..... ZONE ..... STATE .....

IS-10

AMSCO Blast Furnace Small Bell Rings Up a Record

Over a million-and-a-half tons of material battered past it during a full furnace campaign!

When you don't have to stop steel production to change Blast Furnace Small Bells during a furnace campaign, production can only go in one direction—*up.*

A large midwestern steel company installed a small AMSCO Manganese Steel bell in its number 1 furnace in December 1944. 1,575,000 tons of limestone, coke, and iron ore and six-and-a-half years later, the bell was removed from the furnace *after a full campaign!*

When it was removed in August, 1951, the metal around the base had worn from an original thickness of 2¼ inches to one quarter of an inch.

At a time when continuous production is imperative, the use of Amsco Blast Furnace Small Bells, Seats, Bell Rod Shields, and Receiving Hopper Wear Plates will assure minimum distributor maintenance, help avoid shutdowns, and lost production.

Manganese Steel castings are service-proved in operations where high resistance to impact and abrasion are required.

American Manganese Steel is "the toughest steel known" for blast furnaces, coke plants, rolling mills, and foundry equipment parts. Whatever your requirements are, you'll get longer wearing life and greater economy when you specify AMSCO.

WHEREVER YOU MEET A PROBLEM OF WEAR CAUSED BY IMPACT AND/OR ABRASION . . .

. . . find out about longer-lasting, dollar saving manganese steel made by AMSCO . . . world's largest producer of Manganese Steel Castings for all industry.

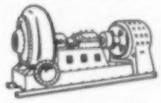
AMSCO controls impact and abrasive wear in 5 basic industrial operations:

Power Transmission

Mining and Excavating

Transportation

Crushing and Pulverizing

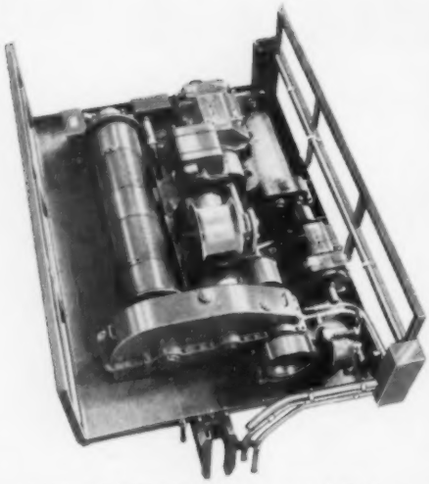


Materials Handling

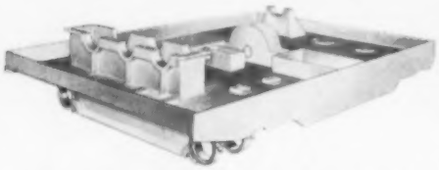
Brake Shoe **AMERICAN MANGANESE STEEL DIVISION**

411 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

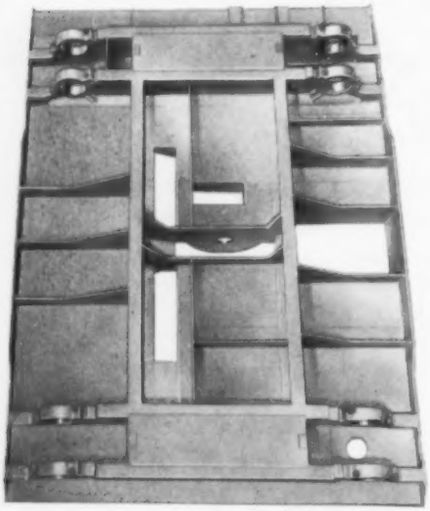
Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que.
Amsco Welding Products distributed in Canada by Canadian Liquid Air Co., Ltd.



COMPLETE TROLLEY — Trolley and hoist machinery arrangement with motors, brakes, gear housings, and pedestals all mounted on top to give maximum lift and unusual accessibility.



TOP VIEW OF FRAME — Frame is all steel, welded to form a one-piece unit with maximum strength and rigidity in all directions. Gear cases and pedestals are built integral with the frame.



BOTTOM VIEW OF FRAME — Frame is effectively braced in all directions. Axle bearing seats are bored and split diagonally to facilitate servicing, and to transmit thrusts directly to frame.

BUILT TO A.I.S.E. SPECIFICATIONS . . .

Typical of the "Shaw Box" interpretation of the new A.I.S.E. Steel Mill Crane specifications is this 15-ton capacity, 61' 8" span single hook crane with single A-5 bridge drive.

Notice the clean cut appearance and rugged simplicity of the trolley details illustrated at the left. This sturdy construction includes oil-tight integral gear cases, pedestal bearings integral with the totally decked and toeboarded frame, sheave supports mounted above the frame, and accessibility of all parts for easiest maintenance.

This is representative of the advantages to be gained through advanced "Shaw-Box" engineering techniques, careful workmanship, exacting standards, and proven experience. It insures efficient, dependable, low-cost crane service with minimum maintenance under the most severe operating conditions.

"Shaw-Box" Cranes are recognized for these qualities in mills all over the country, and for their impressive records of service and performance. For Steel Mill Cranes built to fully interpret A.I.S.E. specifications at attractive prices, look to "Shaw-Box."

BE SURE TO SEND ALL YOUR INQUIRIES FOR STEEL MILL CRANES AND SOAKING PIT CARRIAGES TO "SHAW-BOX"

"Shaw-Box" CRANES

MANNING, MAXWELL & MOORE, INC.

Muskegon, Michigan

Builders of "Shaw-Box" Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties. Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, and 'American' Industrial Instruments.

Specify SQUARE D Motor Starters for 3 Important Reasons

Easy to Wire!

Plenty of wiring space.
Handy solderless terminals.

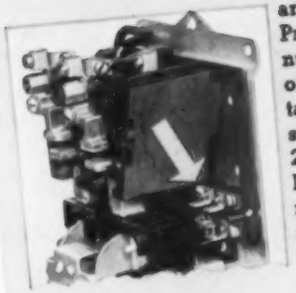
Easy to Get At!

Coils, contacts or overload relays can be changed in no time at all—without disturbing external connections.

Easy to Live With!

Straight line guided motion minimizes wear; large silver alloy contacts insure trouble-free electrical performance.

"Off-the-Shelf" Parts Kits make normal maintenance easier than ever. Each kit contains parts necessary to replace all load contacts and finger springs. An illustrated service bulletin is enclosed to provide quick parts identification and complete installation instructions.

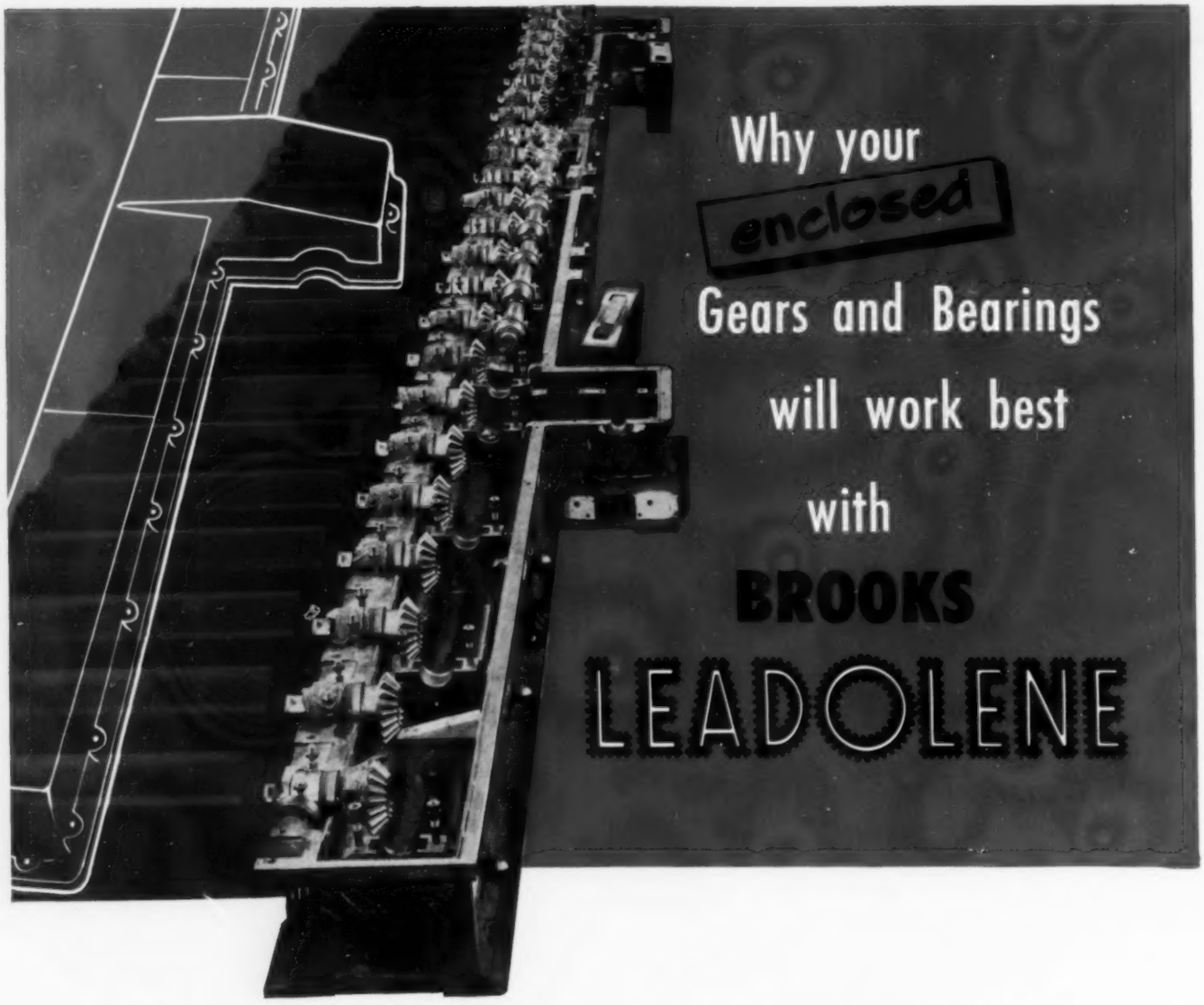


ELECTRICAL INTERLOCKS are available in kit form. Practically any necessary number or arrangement of extra interlock contacts can be added to any standard starter. Sizes 2 and 3 starters will soon have new front-of-panel mounting interlocks for easier installation.
(See cutaway at left)

Write for Bulletin 8536.
Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY



Enclosed gears . . . with their close tolerances, high speeds, shock loads, and great bearing and tooth loads . . . operate best when protected by Brooks LEADOLENE. With its "Indestructible pH-ilm Strength," this lead-based lubricant is definite assurance against pitting, galling, finning of teeth and abnormal bearing wear. The lubricating efficiency of LEADOLENE is not affected by water.

The following case history indicates the kind of service you can expect from LEADOLENE: "*Although a good quality lubricant was used in a certain Cleveland plant's enclosed gear reduction units . . . the gears, bearings and shaft journals required replacement so frequently that the reductions were taken apart every four months. At that time they were cleaned, some replacements were made and new lubricant was added. When LEADOLENE No. 90 was adopted as the lubricant, the reductions were operated for over two years with no replacements and no serious wear.*"

For reduction gear sets . . . mill table gear drives . . . or any other enclosed gear application—you will profit by standardizing on Brooks LEADOLENE as your lubricant.

WRITE for the 20-page brochure, "The Brooks Oil Story". . . or for consultation by a Brooks Engineer.

With LEADOLENE you get these characteristics

pH-ilm Strength . . . 30,000 psi minimum.

Adhesiveness . . . Affinity for metal develops maximum adhesion providing permanent coating on gears.

Water Repellence . . . Effectiveness is not reduced by water.

Corrosion Prevention . . . Never acidic and will not etch or corrode.

Compounded Stability . . . Will not bleed or change physical condition within a greater temperature range.

Low Temperature Factors . . . Does not harden, crack or decrease in adhesion.

Abrasive Resistance . . . Repellent to adhesion of scale, metallics and other contamination.

THE BROOKS OIL CO.

Since 1876

Executive Offices and Plant . . . . . **Cleveland, Ohio**
Executive Sales Offices . . . . . **Pittsburgh, Pa.**
Canadian Offices and Plant . . . . . **Hamilton, Ontario**
Cuban Office . . . . . **Santiago de Cuba**

Washed iron ore is stacked at rate of 600 long tons per hour by this 570 ft. track-mounted trailer belt conveyor (fed by fixed belt conveyor) and Link-Belt 115 ft. radius revolving, self-propelled stacker, which can make storage pile 42 ft. high.

Rely on one source... one responsibility for the best in belt conveyors

LINK-BELT engineering experience plus quality components combine to cut handling costs

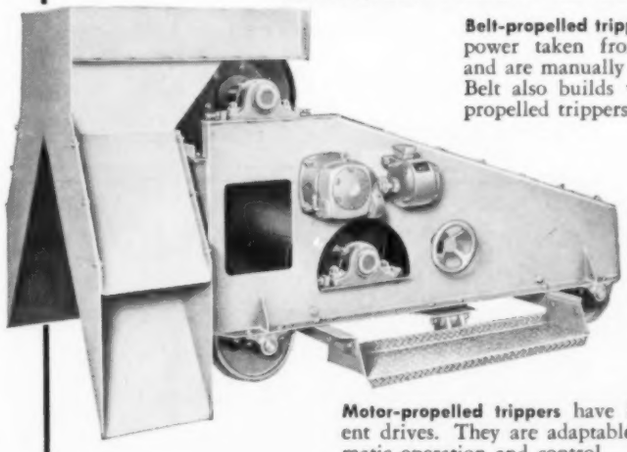
WHETHER you must move a few tons a day or several thousand tons per hour . . . whether the haul is measured in feet or miles—you'll find the answer in belt conveyors at Link-Belt.

Here's a nation-wide engineering organization that will follow through from start to finish—the designing, manufacturing, erecting of conveying equipment. And nowhere can you match Link-Belt's combination of vast application experience . . . complete line of quality components . . . expert coordination of related equipment.

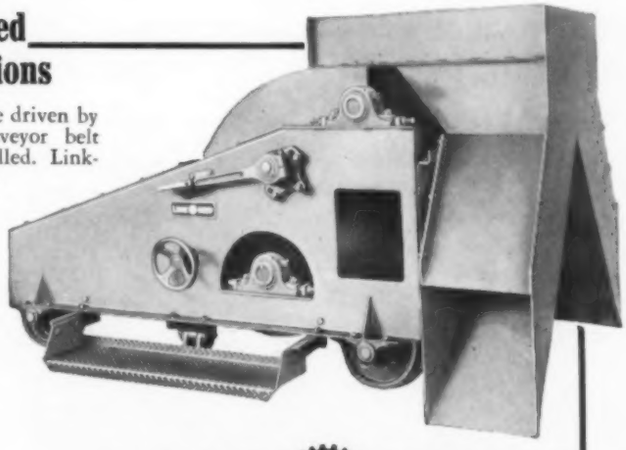
Get all the facts from the Link-Belt office near you. Link-Belt engineers are glad to work with you and your consultants—help you get the finest in belt conveyors.

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, Duluth, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities.

LINK-BELT Trippers offer controlled distribution under all conditions



Belt-propelled trippers are driven by power taken from conveyor belt and are manually controlled. Link-Belt also builds winch-propelled trippers.



Motor-propelled trippers have independent drives. They are adaptable to automatic operation and control.

12,685-B

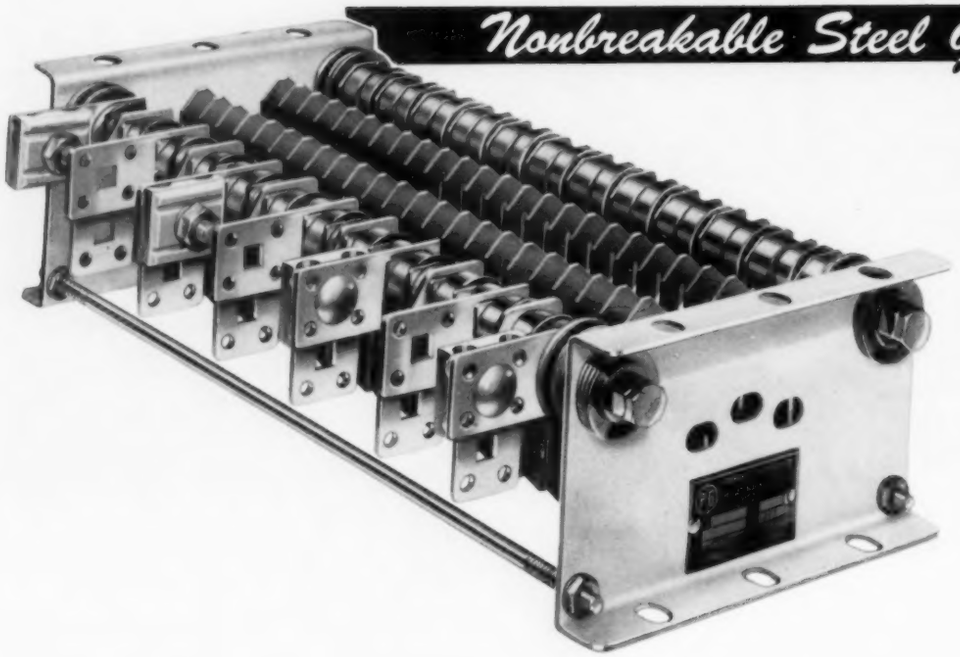
LINK-BELT

BELT CONVEYOR EQUIPMENT

when PERFORMANCE

IS IMPORTANT TRY . . . POST-GLOVER

Nonbreakable Steel Grid Resistor



- All Steel Construction
- Mica Insulation
- Corrosion Resistant
- Unaffected by Vibration or Moisture
- Provision for Expansion
- Adequate Ventilation
- Rugged Terminals

Rugged

Built of Steel and Mica—nothing to break. Light in weight yet dependable. Remarkably constant resistance values regardless of temperature or age.

Original Grid Design

Provides a shape assuring maximum ventilation. Heat is evenly distributed. With all parts of grid equally exposed, heat is rapidly dissipated.

For any job

Where constant "trouble free" resistor service is wanted . . . you can safely specify P-G Steel Grid Resistors and get better performance with lower maintenance.

Complete data given in **BULLETIN No. 500** . . . Copy on request.

P-G

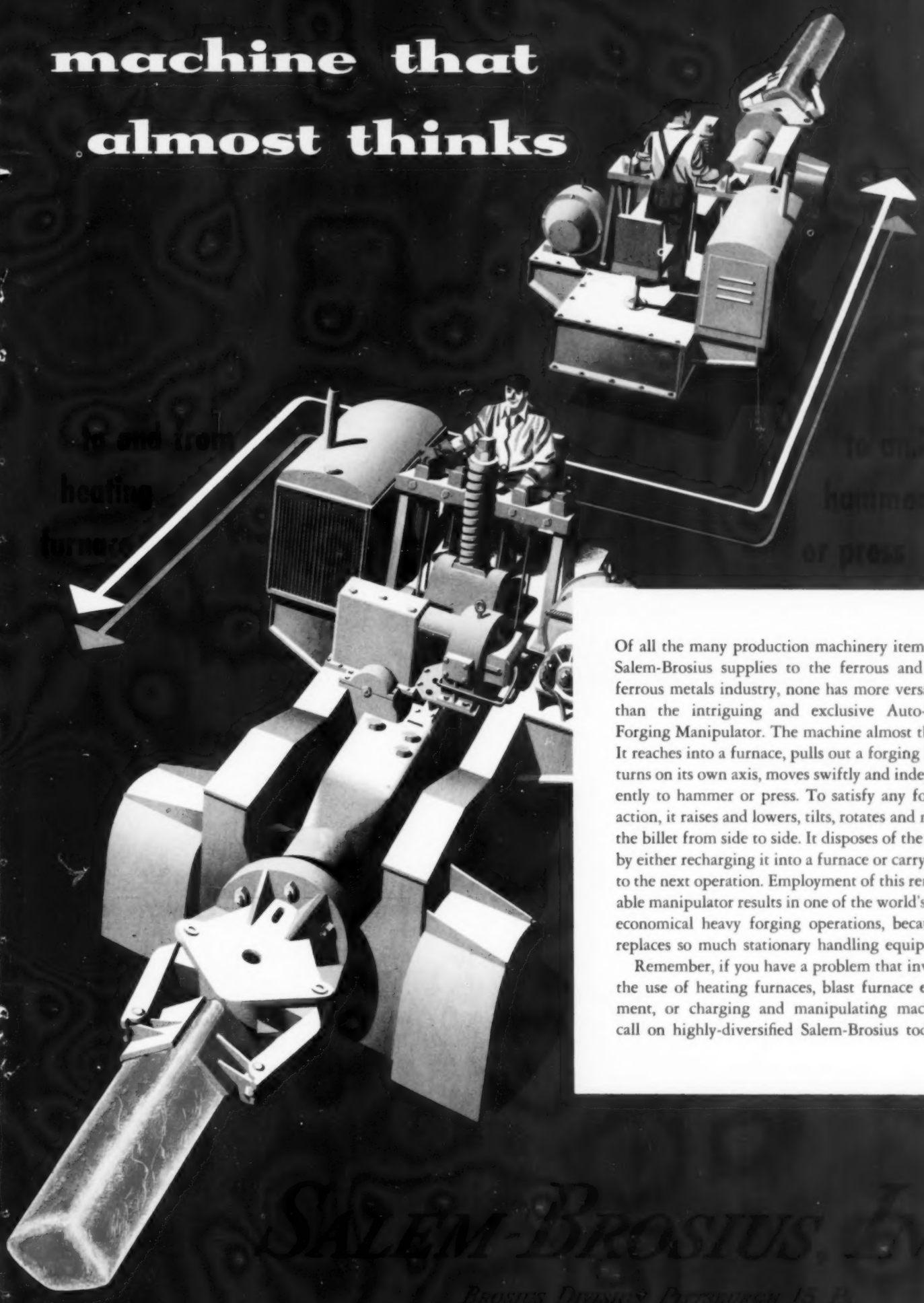
The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

machine that almost thinks



Of all the many production machinery items that Salem-Brosius supplies to the ferrous and non-ferrous metals industry, none has more versatility than the intriguing and exclusive Auto-Floor Forging Manipulator. The machine almost thinks. It reaches into a furnace, pulls out a forging billet, turns on its own axis, moves swiftly and independently to hammer or press. To satisfy any forging action, it raises and lowers, tilts, rotates and moves the billet from side to side. It disposes of the piece by either recharging it into a furnace or carrying it to the next operation. Employment of this remarkable manipulator results in one of the world's most economical heavy forging operations, because it replaces so much stationary handling equipment.

Remember, if you have a problem that involves the use of heating furnaces, blast furnace equipment, or charging and manipulating machines, call on highly-diversified Salem-Brosius today.

SALEM-BROSIUS, INC.

Brosius Division, Pittsburgh 15, Pa.

Salem Engineering Division, Salem, Ohio

THE MORGAN EJECTOR

creates no air traffic hazard

Why invite disaster with expensive, old-fashioned stacks when a low, modern Morgan Ejector will do the job better and at far less cost?

Want proof?

CCC-32

MORGAN CONSTRUCTION CO.

WORCESTER, MASSACHUSETTS

ROLLING MILLS • MORGOIL BEARINGS • WIRE MACHINERY
COMBUSTION CONTROL • PRODUCER GAS MACHINE

HOW IT OPERATES

Cool air is directed upward through the venturi throat, creating a powerful suction in the stack. Superheated gases, fumes, etc., are drawn out without passing through the fan. The gases are mixed with cool air and discharged at low temperature to the atmosphere.

THE IMPROVED

Exide-Ironclad

BATTERY

OUTSTANDING NEW FEATURES INCLUDING

the polyethylene insulating tube sealer combine to make Exide-Ironclad, *more than ever before*, YOUR BEST POWER BUY . . . AT ANY PRICE.

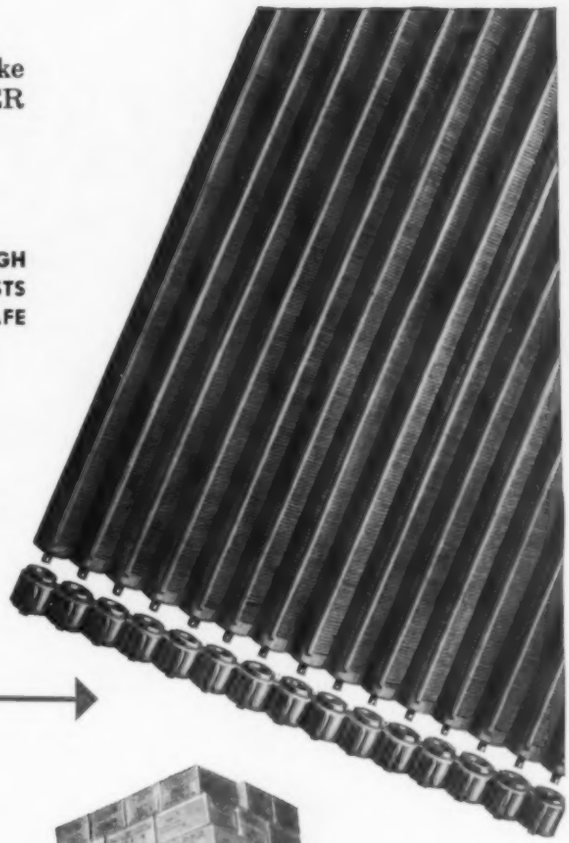
THE IMPROVED EXIDE-IRONCLAD IS BUILT TO GIVE YOU . . .

RAPID ACCURATE HANDLING . . . UNIFORM RATE OF HANDLING . . . HIGH AVAILABILITY . . . LOW OPERATING COSTS . . . LOW MAINTENANCE COSTS . . . LOW DEPRECIATION COSTS . . . HIGH MANEUVERABILITY . . . SAFE HANDLING.

BECAUSE OF . . .

IMPROVED POSITIVE PLATE CONSTRUCTION. The long-life grids now contain SILVIUM—an alloy of silver, lead and other components—which make them highly corrosion resistant.

. . . the New Polyethylene insulating tube sealer of acid-proof, non-corroding plastic. It fits snugly into slotted tubes of positive plate, and reduces loss of active material. Even the small sediment deposit of the past is reduced 50%. Thus more active material remains available, and the high battery capacity is maintained for a longer working life.



IMPROVED NEGATIVE PLATES for higher electrical efficiency.

NEW SEALING COMPOUND—provides permanent seal between jar and cover.

SEAMLESS SHOCK-PROOF JAR, of high quality rubber combines tensile strength and elongation for long-life and heavy-duty service.

NEW UNBREAKABLE PLASTIC VENT PLUGS of polyethylene.

TYPES, SIZES AND CAPACITIES for all kinds and makes of battery-electric trucks—hand and rider.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 2
Exide Batteries of Canada, Limited, Toronto

1888
DEPENDABLE BATTERIES FOR 64 YEARS
1952

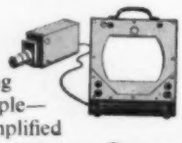
"EXIDE-IRONCLAD" and "SILVIUM" *Reg. T.M. U.S. Pat. Off.*

Announcing...RCA Industrial TV

offering 5 important features

Now RCA offers closed-circuit (wired) television specially designed for all types of industrial applications. By means of this new type of Industrial Television, you can maintain continuous visual checks on remote, inaccessible, or hazardous operations—from one or more points—with clear, high-contrast pictures. RCA Industrial TV has the following five important features.

1. Simplicity



A rugged camera tube (Vidicon)—operating on an entirely new principle—has made possible the simplified RCA Industrial Television system. Camera and monitor are connected by a single cable. No intermediate equipment is necessary. No more tubes than an ordinary home television set. To place in operation, merely connect to 110 volts, 60 cycle AC.

2. Compactness

RCA's new Industrial Television Camera (3" x 5" x 10")—about the size of a 16mm movie camera—weighs only 7½ lbs. Using the Vidicon Tube, this camera is the smallest design available.

3. Ease of Operation

All controls—including those for the camera—are located on the monitor. For fixed operating conditions, once this system is set up, all necessary adjustments can be made with only two knobs . . . operation has been so simplified, anyone can learn to obtain a clear picture in a few minutes.

4. Picture Quality

With an RCA Industrial TV you can obtain high quality pictures without excessive illumination. Scanning frequencies are 525 lines, 30 fields, 60 frames, interlaced . . . the same as standard broadcast television. This permits home television sets to be used as auxiliary viewers.

5. Ease of Service

Carefully engineered simplification of circuits and components has resulted in dependability and ease of service and preventive maintenance. When you buy RCA Industrial Television, you can also buy an RCA Service Plan—complete nation-wide service by trained experts of the RCA Service Company.

For information on RCA Industrial Television, **ATTACH COUPON TO YOUR LETTERHEAD**

RADIO CORPORATION of AMERICA
INDUSTRIAL EQUIPMENT CAMDEN, N.J.

RCA Industrial Products
Dept 188 J Bldg.-15-7
Camden, New Jersey
In Canada: RCA VICTOR Company, Ltd., Montreal

Please send me information on RCA Industrial Television

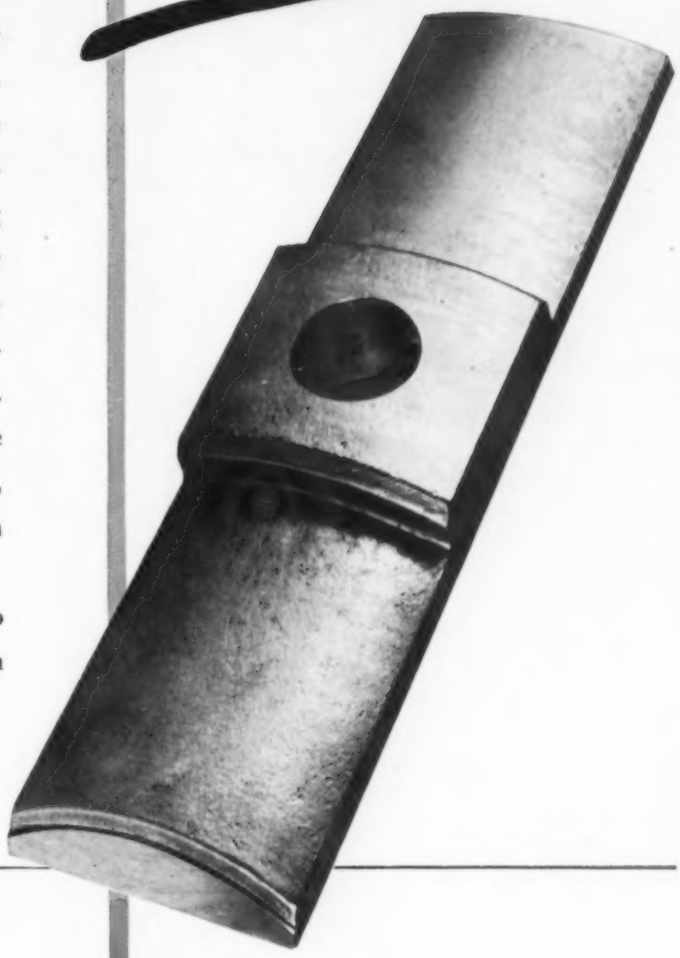
We Serve Steel Better Than Best

Knowing Copper Alloys

We specialize in copper and copper-base alloys such as bronze. And we cast these metals for steel industry use by the most advanced methods. For example . . . this manganese bronze slipper is made by our permanent mold technique and requires *no machining* after casting except for the pin hole. Oil grooves are actually cast-in. Surface hardness is completely controlled, and our customers realize dollar savings through our production-run economies.

National Bearing Division offers you the benefits of more than 50 years of experience, metallurgical research and production-run facility development.

Our 6 centrally located plants are ready to serve you. Contact National Bearing Division for full information.



A FEW NATIONAL BEARING STEEL INDUSTRY PRODUCTS: Bosh Plates • Monkeys • Tuyeres • Coolers • Mantel Plates • Stack Plates • Roll Neck Bearings • Housing Nuts • Babbitt Metals • Slippers

You're invited to visit us at our plant in Meadville, Pa. . . . We'll be glad to have you know us better.

Brake Shoe

NATIONAL BEARING DIVISION

4936 Manchester Avenue • St. Louis 10, Mo.

PLANTS IN: ST. LOUIS, MO • MEADVILLE, PA. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

This big Cleveland semi-gantry crane, weighing 300 tons, serves four Bessemer converters, three of which are active. The fourth, visible at far right, is held for standby use. Each converter will produce 25 tons of steel in less than 20 minutes.

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

CLEVELAND ALL-WELDED GANTRY CRANE
AT NATIONAL TUBE COMPANY, LORAIN WORKS

The 125 ton single-leg gantry crane installed at the National Tube Company, Lorain, Ohio, in 1949, to serve the Bessemer converters, is unusual, not only because it is the largest of its type ever built, but also because of its shaftless bridge drive.

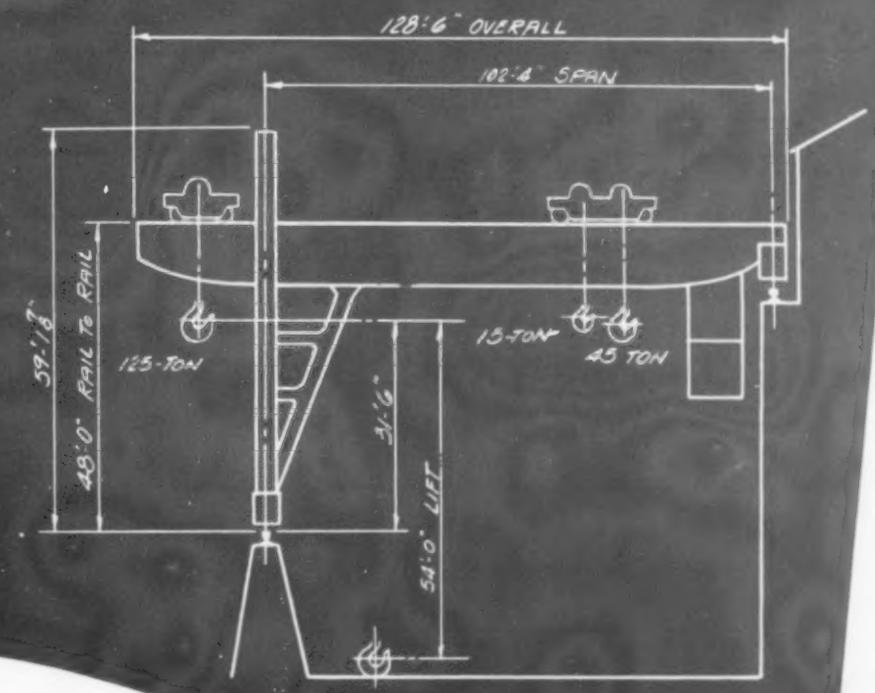
Heretofore bridge drives for all long span semi-gantries have employed motors, mounted on the bridge girders, arranged to drive the track wheels through line shafting, flexible couplings, bevel gears and universal joints. Most of these have been a source of maintenance difficulties to users.

The all-welded design of this crane, incorporating a welded box-section portal-type leg, provides maximum torsional rigidity to assure proper alignment of all parts and successful operation of the individual motor bridge drives. The hermetically sealed welded box sections used for both girders and leg, provide maximum resistance to corrosion, always a problem in the Bessemer area.

The bridge of the crane rides on eight equalizing-type two-wheel trucks, four of which are located at the gantry leg and four at the wall end of the crane girders. For each pair of trucks there is a direct connected individual motor drive, making four bridge drive motors in all. No provision is made to electrically synchronize the motors.

A variety of applications are being served by heavy-duty all-welded Cleveland Cranes of various types in mills of nearly all the important American steel producers.

THE CLEVELAND CRANE & ENGINEERING CO.
1131 EAST 289TH ST. • WICKLIFFE, OHIO



The crane is equipped with two trolleys, one with a 125 ton hoist and the other with a 45 ton and a 15 ton hoist. It is powered with 9 motors.

"Tycol Anepro carries heaviest loads... lowers bearing failure...slices lubrication costs"

Indeed it does! Tycol Anepro Greases measure up to severest shock-load conditions encountered in the rolling of steel. They protect bearings from moisture, heat, and abrasive impurities. Anepro's exceptionally high film strength and non-corrosive properties result in far longer bearing life . . . faster rates of production . . . minimum down-time for heavy-duty equipment.

Call or write today for complete information from your nearest Tide Water Associated office.

TYCOL

INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh
Philadelphia • Chicago • Detroit
Tulsa • Cleveland • San Francisco

TIDE WATER ASSOCIATED OIL COMPANY

17 BATTERY PLACE · NEW YORK 4, N.Y.

SEND FOR A FREE COPY OF "TIDE WATER ASSOCIATED LUBRICANIA"

Resists Corrosion!

Reduces Costs!

Wringer Roll fabricated from AMPCO* METAL

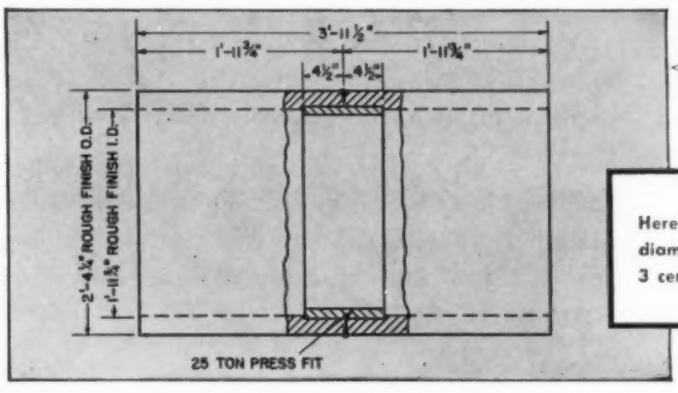
— just the thing for a continuous pickling line . . . less downtime, more production

Yes, Ampco Metal resists corrosion as well as wear, pressure, impact and shock.

It's easy to fabricate, too, thanks to Ampco-Trode* Bronze Electrodes which have the same wear- and corrosion-resistant qualities as the parent metal.

And here's the payoff! Wringer rolls fabricated from corrosion-resistant Ampco Metal help you reduce replacement costs—cut down-time losses.

Ampco Metal is ideal for countless steel mill applications—wear plates, slippers, screw-down nuts, flash-welder dies, pickling equipment etc. Discuss your wear and corrosion problems with your nearby Ampco field engineer. He can show you where tough, wear- and corrosion-resistant Ampco Metal can keep production up and costs down.



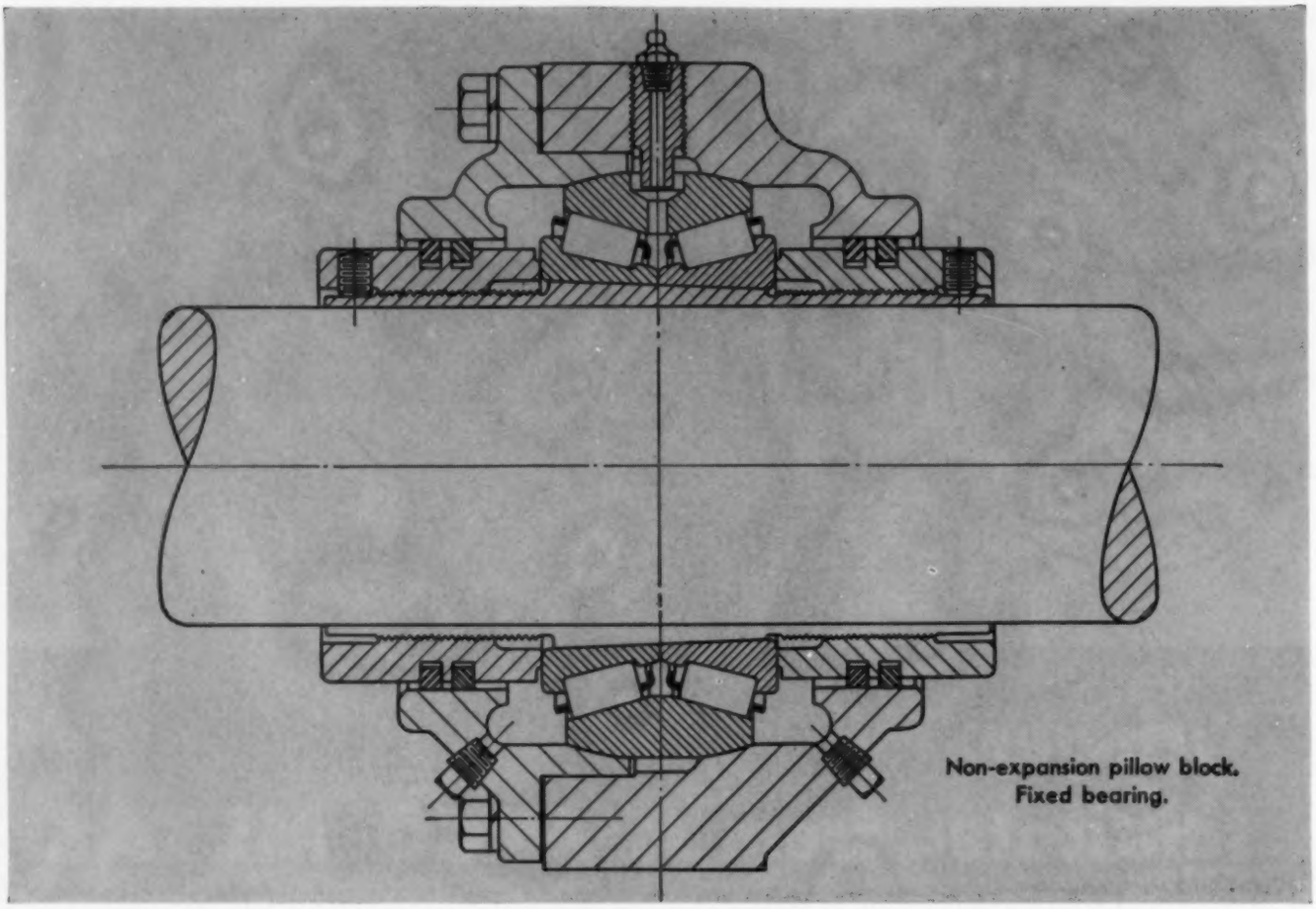
Here's a drawing of the wringer roll you see pictured above. Outside diameter of roll is 2'-4¼", overall length 3'-11½. It was fabricated from 3 centrifugally cast sections of Ampco using Ampco-Trode 160 electrodes.

Ampco Metal, Inc.
1745 South 38th Street, Milwaukee 46, Wis.
West Coast plant: Burbank, California

*Reg. U. S. Pat. Off., Ampco Metal, Inc., Milwaukee, Wis.

G-7

NEW TIMKEN® ROLLER



Non-expansion pillow block.
Fixed bearing.

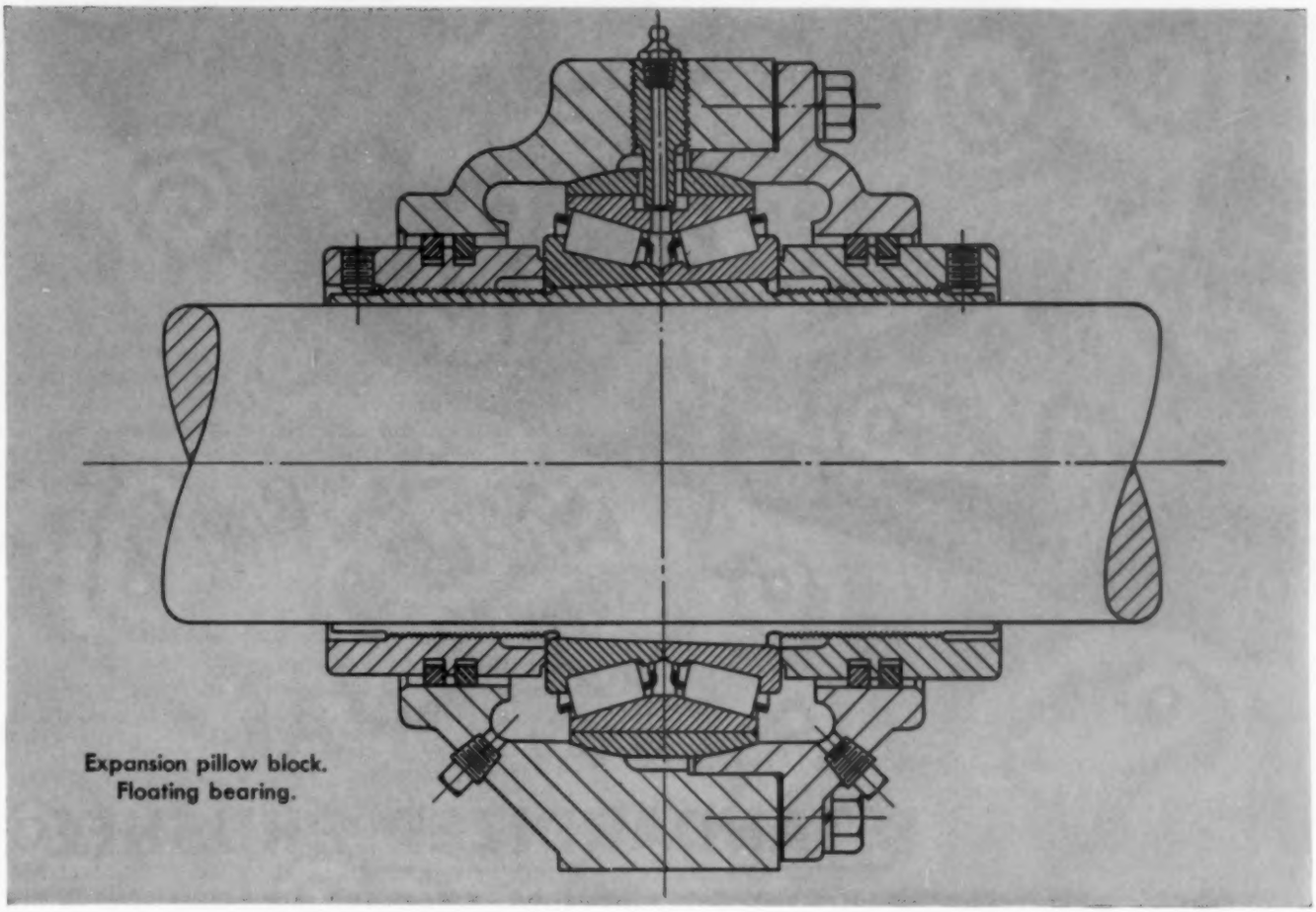
First application of new tapered makes new Dodge-Timken®

IT takes up less space. It weighs less. Yet the new Dodge-Timken® All-Steel pillow block has tremendous load-carrying capacity.

It's the result of the combined achievements of the Dodge Manufacturing Corporation, Mishawaka, Ind., and The Timken Roller Bearing Company and makes use of an entirely new Timken bearing. Never before has a self-aligning, non-adjustable tapered roller bearing with tapered bore been used in pillow blocks.

Being of all-steel construction, this new Dodge-Timken pillow block is more compact and fills a real need where space is a factor. It is available in both expansion and non-expansion designs. And it incorporates all the advantages of Timken tapered roller bearings.

BEARING PILLOW BLOCK



Expansion pillow block.
Floating bearing.

bore TIMKEN® bearing pillow block more compact

Because of their tapered construction, Timken bearings take radial and thrust loads in any combination. Line contact between rollers and races gives Timken bearings load-carrying capacity to spare. Timken bearings are made of the finest steel ever developed for tapered roller bearings—Timken fine alloy steel—and under normal conditions will last the life of the machinery with which the pillow blocks are used.

When you install new Dodge-Timken pillow blocks, you can expect dependable performance because the bearings are the best. No other bearing can give you all the advantages you get with Timken bearings. Specify them for all your other machinery, too. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

When You Want 'Em...

NATIONAL
TRADE-MARK

STANDARDIZED BRUSHES

Quick Delivery... is assured with "NATIONAL" STANDARDIZED BRUSHES because they are *shipped from stock.* You get them WHEN you need them and you simplify storekeeping. In fact, FASTER DELIVERY . . . made possible by National Carbon's unequalled manufacturing facilities and streamlined processing technique . . . is an important advantage of *all* "National" brushes, whether they are shipped from stock or made to order.

Don't forget, too, that you can buy "National" STANDARDIZED BRUSHES at the same LOW, FLAT PRICE for 100 or 100,000 brushes!

Write for Bulletin CP-2426 "National" Standardized Brushes

DOLLARS and SENSE...

point to "Eveready" No. 1050 Industrial Flashlight Batteries . . . delivering twice as much usable light as any battery we've ever made before. Their unique construction prevents swelling or jamming in the case...has no metal can to leak or corrode.

NATIONAL **STANDARDIZED BRUSHES**

BETTER– PRODUCT–PACKAGE–PRICE– FASTER

The terms "National", "Eveready" and the Three Pyramids device are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices:
Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

In Canada:
NATIONAL CARBON LIMITED
Montreal, Toronto, Winnipeg

Crops *and* Shorts

NOW that the 1952 AISE Convention and Iron and Steel Exposition is over and we can survey the statistics, we can feel only gratitude toward all who helped to make the record-breaking affairs so successful. Total registration reached an all-time high of 14,795. The Exposition included 411 booths displaying the products of 190 companies, and many new developments were shown. The technical program was excellent and the sessions well attended. The annual dinner was attended by 1125 people.

The fine facilities offered by Cleveland Public Auditorium and the smooth handling of social affairs by Hotel Statler, coupled with the cooperation of the Cleveland Convention and Trade Show Bureau, certainly bore out AISE president I. N. Tull's remark that "Cleveland is the best darn convention city in the country."

▲

NOTEWORTHY at the Iron and Steel Exposition was the unusually high interest created by the various displays. Extensive use of models, the showing of really new developments, and ingenious methods of presentation combined to attract attention and draw in the potential buyers. The pulling power of the displays is a credit to the exhibitors themselves, who thus earned the fine results which they, with few exceptions, enjoyed. That their efforts were appreciated was evidenced by the comments of their customers.

▲

INCIDENTALLY, the Factory Stores booth at the Iron and Steel Exposition, featuring free coffee for all who desired, served 12,600 cups during the four days of the show.

▲

OCTOBER 20-26 is "Cleaner Air Week" — and with all that campaign oratory, too.

▲

STATISTICS developed by the Engineering Societies Personnel Service show there are about 340,000 engineers in the United States. They are employed in the various fields as follows: 25.2 per cent electrical, 23.7 per cent mechanical and industrial, 23.6 per cent civil, 9.8 per cent chemical, 7.6 per cent mining and metallurgical, 6.5 per cent other engineering and 3.6 per cent non-engineering. Their duties are administration and management, 40.0 per cent; design, research and development, 32.6 per cent; manufacturing and production, 9.6 per cent; consulting, 8 per cent; sales and editorial, 5.1 per cent; and teaching, 4.7 per cent.

▲

AN optimist is a middle-aged guy who believes the cleaner is shrinking the waistband of his trousers.

▲

STEEL producers in general expect production to be running at about 80 per cent of capacity six months from now.

▲

PERHAPS the trouble with the world is that the nations are living like one big family.

▲

A MAGAZINE reveals its regard for its readers by the type of editorial it publishes.

A company shows its regard for its customers by the magazine through which it approaches them.

▲

TWO research projects have been initiated by the American Iron and Steel Institute to investigate methods for removing the tin from used tin cans, with the idea of recovering the tin as well as about 1,000,000 tons of steel scrap.

▲

WHAT this country needs is someone who knows what this country needs.

▲

NEW methods of concentrating low grade iron ores, more intensive exploration of old ore properties, and new ore discoveries are adding years to the life of the Great Lakes ore fields, according to R. T. Elstad, president of the Oliver Iron Mining division of United States Steel Co., who states that the Lake Superior district will be predominant in the steel picture for many years to come.

▲

THE anonymous author of the following verse from the Highway Builder must have been an engineering society executive.

Will a Secretary Go to Heaven?

If a secretary writes a letter, it's too long.
If he sends a postal it's too short.
If he doesn't send a notice, he's lazy.
If he attends a committee meeting, he's butting in.
If he stays away, he's a shirker.
If he duns a member for dues, he's insulting.
If he fails to collect dues, he's slipping.
If he asks for advice, he's incompetent.
If he does not, he's bullheaded.
If he writes reports complete, they're too long.
If he condenses them, they're incomplete.
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Dust to dust.
If others won't do it,
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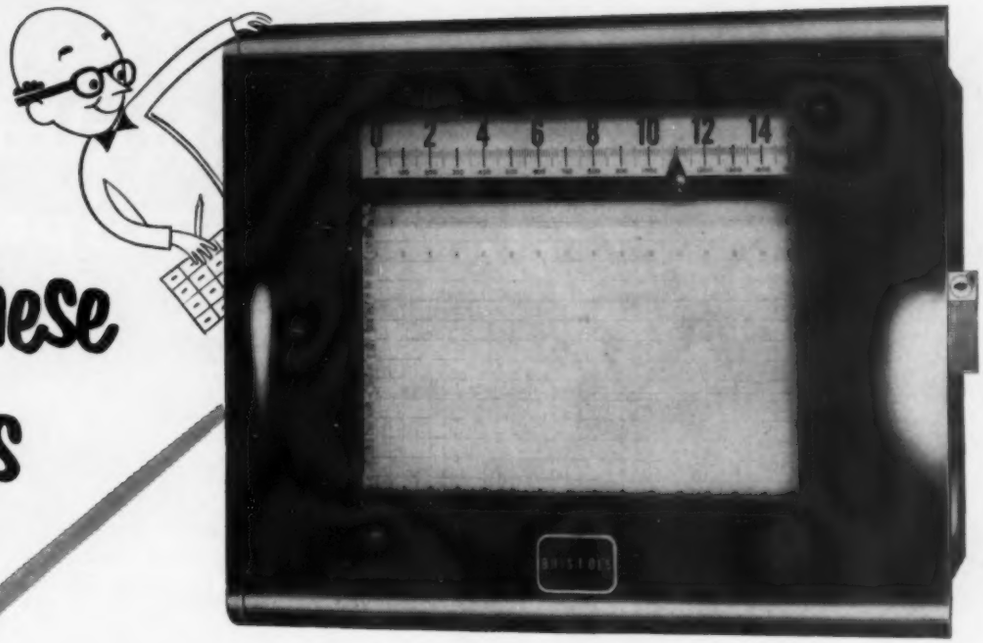

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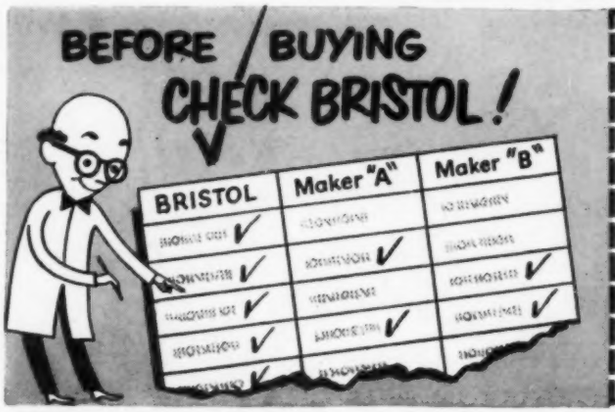

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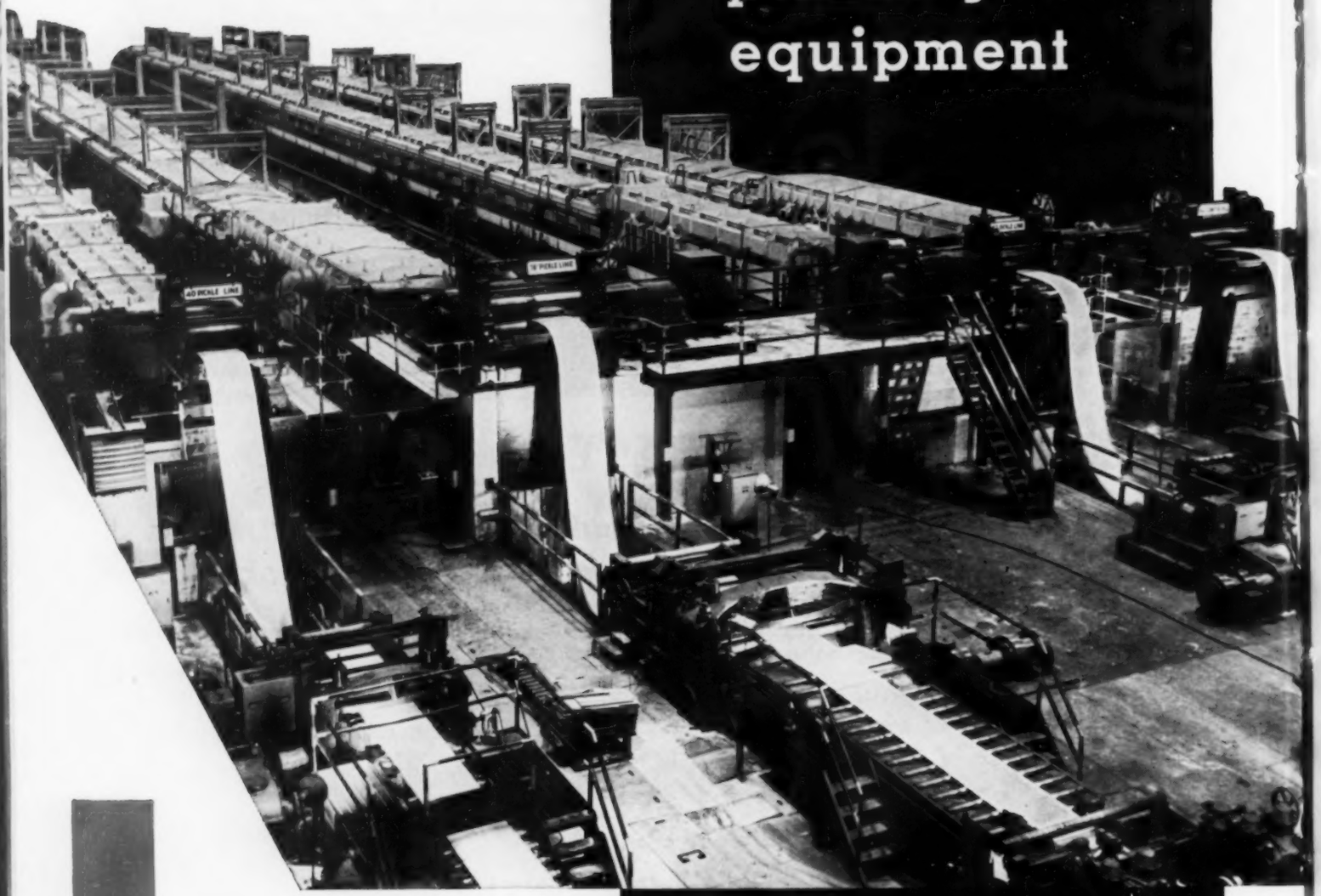

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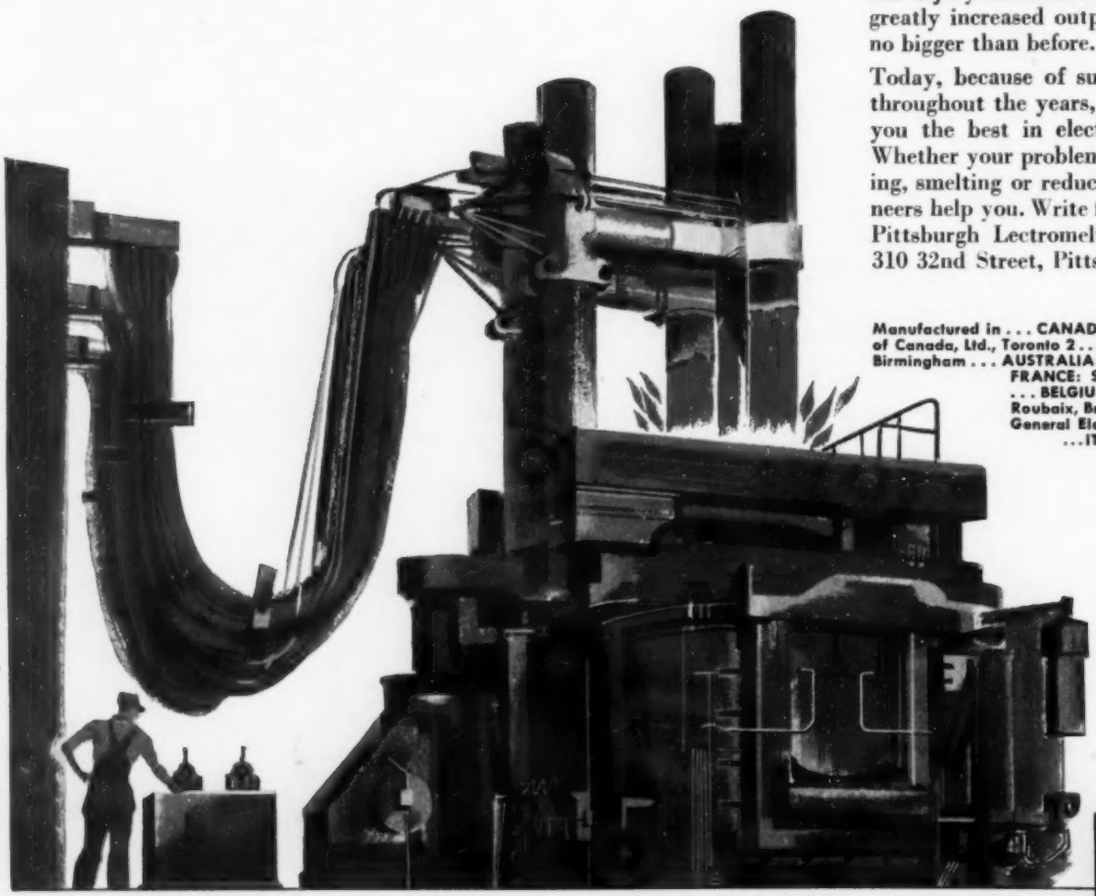

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WHEN YOU MELT... MOORE RAPID *Lectromelt*

Submerged Arc Welding

AT ATLAS STEELS, LTD.

By CARL EKWALL
Superintendent of Maintenance and Service Dept.
Atlas Steels, Ltd.
Welland, Ontario, Canada

. . . . typical applications of this welding method on equipment repairs show marked economies over the cost of purchasing new equipment . . . .

▲ THE submerged arc process is a method of welding in which the heat needed to fuse the metal is generated by the passage of an electric current between a consumable bare metal welding rod and the piece being welded. The tip of the welding rod and the work-piece are not in contact, and both are covered by a layer of granulated mineral welding composition. There is no visible arc and no sparks, spatter, or smoke.

The advantages of submerged arc welding over other welding methods are the result of three characteristics of the process:

1. Heavier welding currents than any other process.
2. Completely automatic control.
3. Exclusion of the atmosphere from the welding zone.

With this process, a supply of the dry, finely-divided, free flowing submerged arc melt is automatically laid down along the seam to be welded at sufficient depth to cover completely the end of the welding rod at all times during the actual welding operation. During welding, the lower portion of the melt surrounding the end of the welding rod becomes molten, while the upper visible portion of the melt remains unchanged and can be reused. Due to the good heat-insulating capacity of the melt, and the high current densities that can be used, an intense heat is concentrated in a relatively small welding zone where the welding rod and base metal are rapidly fused, making possible high welding speeds. Approximately two volumes of base metal are fused for each volume of filler rod added.

High metal deposition rates are the main feature of this process. The metal deposition rates vary directly as the amperage used, and in general the rate is one-half lb of metal deposited per minute per 1000 amperes of welding current. Welding currents of up to 4000 amperes have been used with this process.

Submerged arc welds have excellent strength, ductility, uniformity, fatigue strength, density, shock and corrosion resistance, as well as remarkably low oxygen and nitrogen content. In many cases, the mechanical and metallurgical properties of the submerged arc weld are superior to the pieces welded.

The high quality of submerged arc welds is evidenced by the fact that they meet the rigid specifications of all inspection groups. Welds in all classes of structures are being accepted under the codes of regulations of: ASME Code, Coast Guard, Lloyd's Registry, Interstate Commerce Commission, American Petroleum Institute, United States Navy and American Bureau of Shipping.

Following the introduction of the submerged arc welding process in Atlas Steels Limited in 1947, this equipment has been used continually for a wide variety of maintenance, repair and fabrication work.

Successful submerged arc weld applications include

the rebuilding of furnace wheels, crane wheels, 20-ft long press columns, hammer rams, press rams, cast steel gear blanks, steel mill spindles, mill table rolls, everdur mill slippers and the repair and fabrication of steel freight cars and gondola cars, the broken anvil for a 12,000-lb hammer, alligator scrap shears, hydraulic press cylinders and rotary furnace wheels.

The following comments illustrate typical submerged arc applications in this plant and cost comparisons between submerged arc welding and other processes. In many cases, equipment which was submerged arc welded and placed back in service had no value except as scrap prior to the introduction of the process.

Those who are not using the submerged arc welding process in their maintenance department and are thinking of doing so, it would be wise to make a complete survey of the work available so that the proper equipment to cover the range of sizes and shapes can be set up.

EQUIPMENT REQUIRED

1 Welding head — approximately $1500.00.

2 Electric welding machines, d-c or a generator capable of developing required current.

Necessary rod and melt.

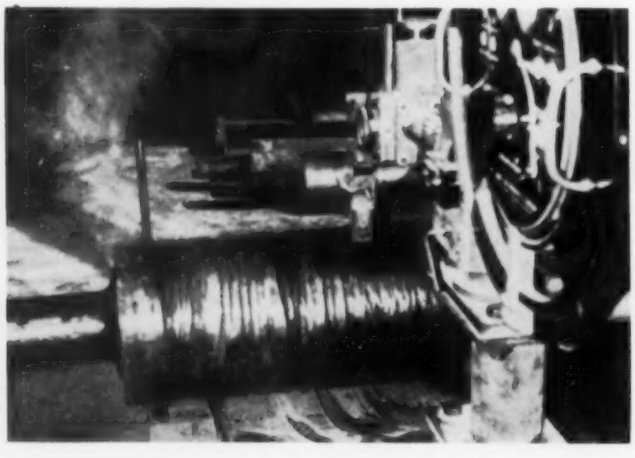
Equipment to mechanically turn or move at required speeds.

SUBMERGED ARC RECLAMATION OF A SCRAP 22-IN. MILL TABLE ROLL

DATA:

Material — Cast steel of 0.30-0.35 per cent carbon.
Size — 2-ft long by 12-in. diam.
Present state — Scrap.
Setup time — 5 min.
Preheat time — 30 min.
Welding time — 6 hr.
Total time for buildup — 8 hr.
Welding speed — 16 in. per min.
Travel speed — 7/16 in. per min.
Buildup — 7/8 in. on the diam.
Current — 550 amp D.C.S.P.
Voltage — 28 v.

Figure 1 — View of roll prior to welding shows gouges or grooves. These grooves, 1/2-in. deep by 3/4-in. wide, resulted from the roll being the first in line from the tilting table.



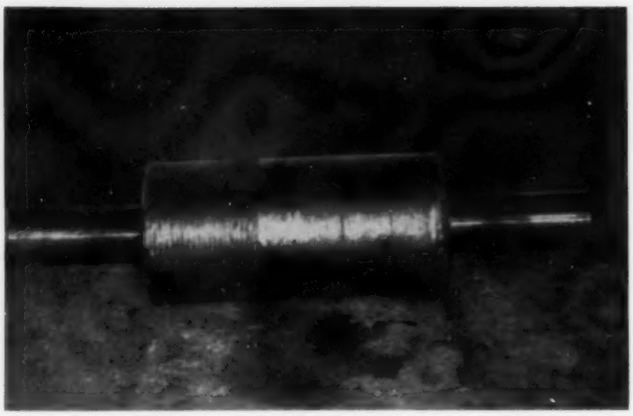


Figure 2 — View of completed roll after welding.

Rod used — 105 lb oxweld grade 40, 3/16-in. diam.
Melt used — 150 lb submerged arc.
Total cost of buildup — Labor plus materials ..... $ 49.35
Cost of new roll (imported) $425.00
Cost of new roll (made in shop) $285.00
Final machine or lathe work — none — Returned to service in as-welded condition.
See Figures 1 and 2.

RECLAMATION OF FOUR SCRAP 1000-TON PRESS COLUMNS

DATA:

Material — Forged steel of 0.35-0.45 per cent carbon.
Size — Columns 20-ft long by 11-in. diam.
Weight of column — 8000 lb.
Present state — Scrap.
Lathe setup time — 12 min.
Preheat time — 12 min.
Welding speed — 16 in. per min.
Travel speed — 7/16 in. per min.
Buildup — 1/32-in. oversize.
Linear feet of weld per column — 1180 ft.
Time to deposit 25 lb — 102 min.
Area covered by 25 lb — 19 to 21 in.
Welding current — 550 amp D.C.S.P.
Welding voltage — 28.
Rod — oxweld No. 40, 1/8-in. diam.

	Column 1	Column 2	Column 3	Column 4
Lb rod used	190	155	190	145
Lb melt used	250	200	250	200
Total welding man-hr (2 men)	27	23	22	19.5
Actual welding time (hr)	15.5	12	15	12
Total welding cost	$104.30	$87.40	$89.90	$75.40
Lathe machine hr	37	37	36	27
Machining and polishing cost	$ 83.25	$83.25	$81.00	$60.75

Cost of new column imported from U.S.A. $2370.00
Cost of new column made in Atlas Steels' shop with their own steel $1740.00
Average cost of rebuilt columns ..... $ 167.00 each

For this buildup work, the columns were rotated in a 15-ft lathe with a double roller support at one end. Two 6-in. flame priming heating heads were attached to the lathe carriage and used to remove grease from the columns and to preheat them to 500 F. During welding, an air-powered grinder with an 8-in. diam. wire buffing brush were attached to the lathe carriage

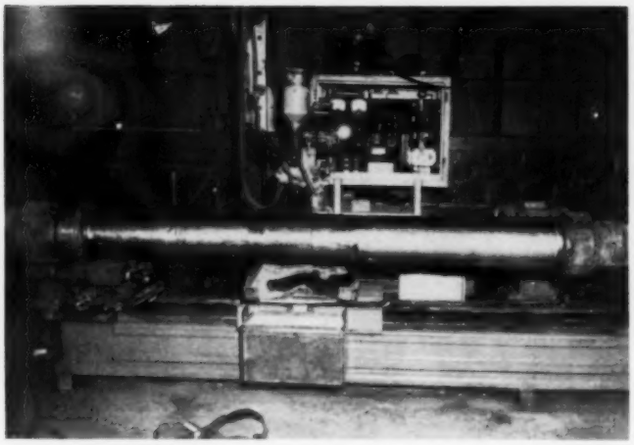


Figure 3 — Column section is shown completely rebuilt. It is 9 ft long by 11 in. diameter. Note direct current welding control panel in background.

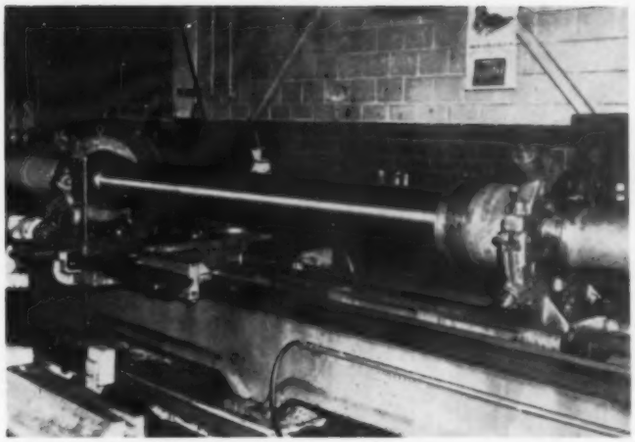


Figure 4 — Column is shown after machining ready for service.

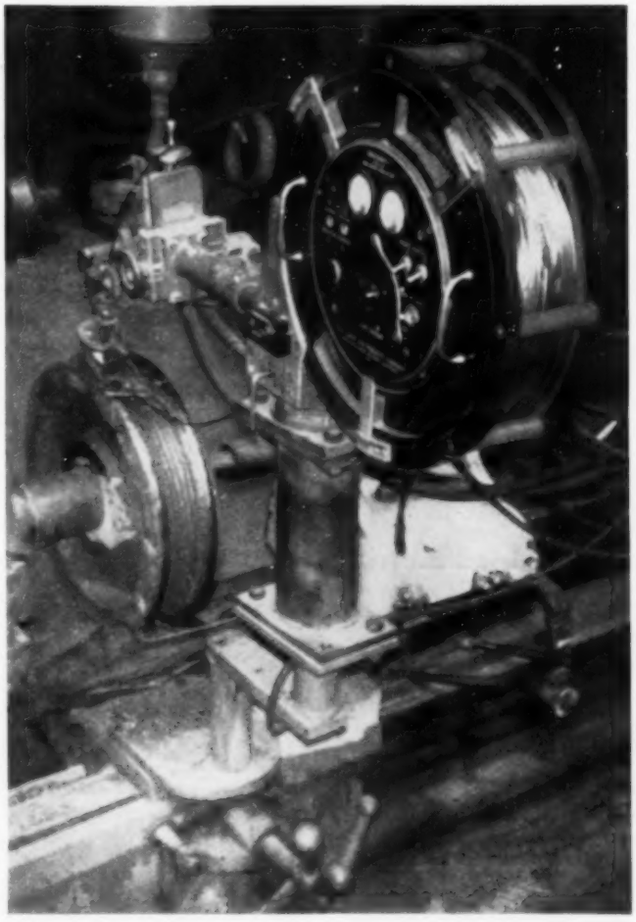
and operated some 18 in. ahead of the welding zone. This removed all grease, soot and rust left after the heating operation. A scraper was also attached to the "D-head" mounting bracket on the lathe carriage to remove solidified melt from the underside of the rotating column. See Figures 3 and 4.

REBUILDING 21-IN. DIAMETER CRANE WHEELS

DATA:

Material — Forged steel.
Size — 21-in. diam by 4-in. face.
Preheated to 400 F, prior to welding.
Total time per wheel — 2-¾ hr.
Rod used per wheel — 25 lb of oxweld No. 40.
Melt used — 50 lb.
Estimated total cost of rebuilding wheel (labor, materials and machining) ..... $ 40.00
Cost of new wheel $240.00

Figure 5 — A "DS"-head setup is shown on post for welding crane wheel.

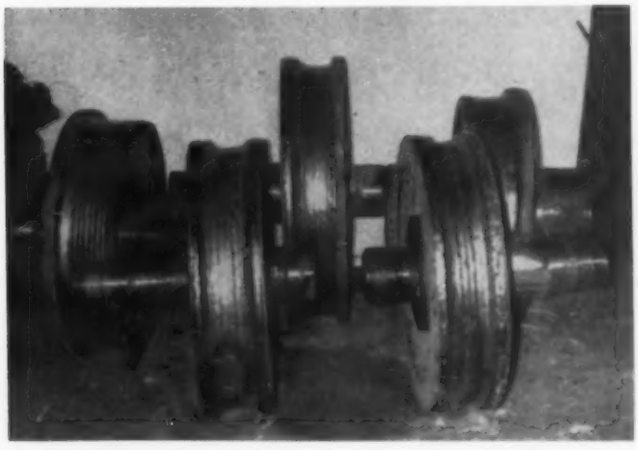


Wheels manual arc welded last three-and-a-half months on the crane before replacement is necessary, while a submerged arc welded wheel has been in service over eleven months without any apparent sign of wear. Welding time by manual arc is 12 to 16 hours per wheel. See Figures 5 and 6.

SUBMERGED ARC WELDING A NEW END ON A BROKEN 26-IN. MILL PINION

The bearing end of a 26-in. mill pinion snapped off through metal fatigue, and it was necessary to machine out a new end and submerge arc weld it on to the old shaft. To do this, both the new part and the broken section of the shaft were machined back to form a bevelled joint. A 4-in. diameter hole was machined in the center of both shafts for lining up purposes, and a 4-in. plug inserted in the holes between the two parts

Figure 6 — Three crane wheels and two 4-ton manipulator wheels are shown welded and ready for machining.



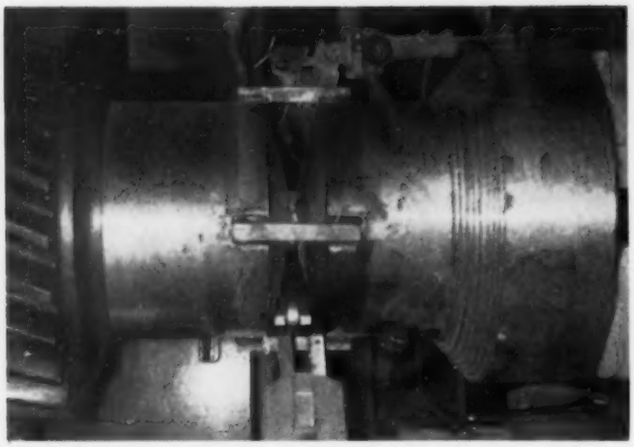


Figure 7 — The two parts are lined up on a 4-in. plug and held rigidly by reinforcing bars.

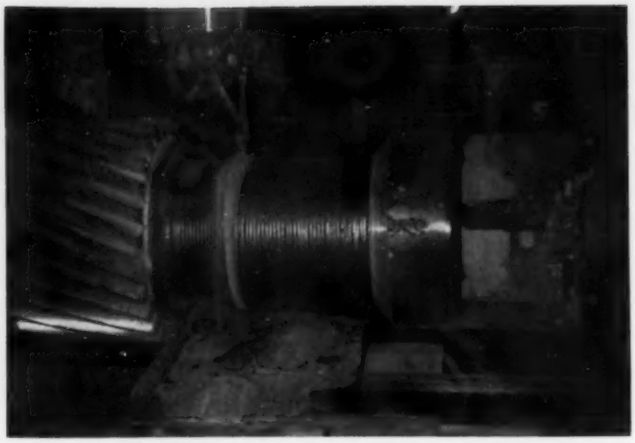


Figure 8 — Welding is almost completed with the V-joint built up and one pass across the top of the shaft.

and the whole lined up in a large press. Reinforcing bars were tack welded between the two parts across the bevelled joint to maintain the alignment while positioning the pinion on a rotator. Then a submerged arc DS-head was positioned over the joint, the reinforcing bars cut off and the whole preheated with oxweld flame heating heads to 700 F. The joint was then submerged arc welded and machined. See Figures 7 and 8.

DATA:

Pinion material — 0.50 carbon steel.
New end — 0.45 carbon steel.
Preheat temperature — 700 F.
Rod used — 275 lb oxweld No. 40, ⅛-in. diam.
Melt used — 400 lb submerged arc.
Amperage — 550 amp D.C.S.P.
Voltage — 30 to 32 v.

BUILDING UP THE BORE OF A 4000-LB HAMMER RAM

The bore of a 4000-lb hammer ram, 6-in. in diameter on the outside and tapered to 5 in. on the inside, was built up ½ in. on the diameter by the submerged arc process. The ram was first wedged and spot welded in slots, 12 in. by 25 in. which had been torch cut in two rings 30 in. in diam from 1½-ft plate. The ram in this manner was placed on four dead rollers for rotating purposes. The welds were made in the longitudinal direction, and the ram was rotated a half-turn after each weld. The welding rod was fed through a brass tubing, 24 in. long, which had a copper nozzle screwed in the goose neck at the welding end of same. The bore of the ram was machined before welding to eliminate any impregnated copper from shims used to hold the hammer rods tight on loose fits. The ram was preheated to 600 F before welding and later stress relieved. It required two passes, 14½ in. long and one pass 8¾ in. long to complete the buildup. See Figure 9.

DATA:

Ram analysis — C—0.44, Mn—0.73, Si—0.20, S—0.018, P—0.029, Cr—0.13, Ni—0.15.
Rod used — 30 lb oxweld No. 36, ⅜-in. diam.
Melt used — 60 lb submerged arc.
Welding speed — 8 in. per min.
Welding current — 550 amp D.C.S.P.
Welding voltage — 30 v.
Preheat time — 3 hr.
Welding time — 8 hr.

REPAIRING A 30-IN. ALLIGATOR SCRAP SHEAR

A cast steel alligator scrap shear recently cracked in operation and was repaired manually using a flexible attachment on a standard DS welding head. (This attachment consists primarily of a 17-ft long flexible tube with a combination melt hopper and nozzle assembly at one end of the tube. The other end of the

Figure 9 — The end of one run is almost completed. The steel rings holding the hammer ram are clearly shown.

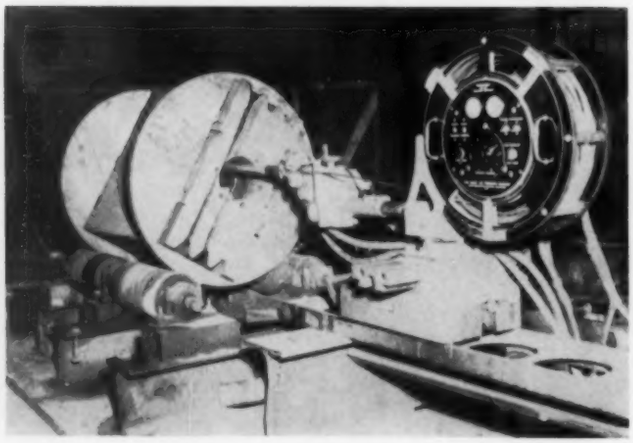


Figure 10 — Shear is shown welded on second side and ready for service.

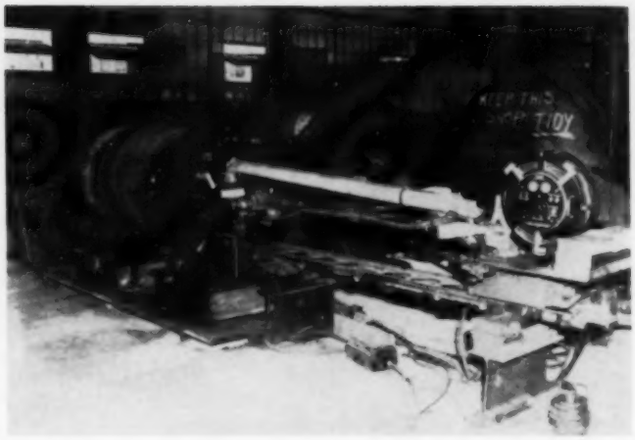


Figure 11 — The general shop setup for welding the cylinder shows extension arm from carriage carrying head and cylinder mounted on variable speed trunnions.

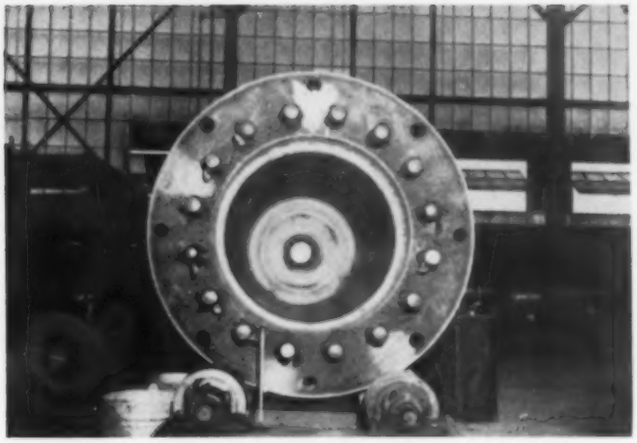


Figure 12 — The completed cylinder is shown before machining.

tube is connected to the welding head allowing this equipment to be used on jobs suitable for manual welding only yet with all the high metal deposit rates of submerged arc welding.)

DATA:

Material — Cast steel.
Rod used — 200 lb oxweld No. 40, ⅛-in. diam.
Melt used — 300 lb submerged arc.
Welding current — 600 amp D.C.S.P.
Welding voltage — 32 v.

It is estimated that the savings in labor and material using this process instead of the conventional thermite welding process amounted to $256.00. See Figure 10.

WELDING A HYDRAULIC PRESS CYLINDER

The 24-in. inside diameter hydraulic press cylinder on a 1000-ton press failed in the cast iron liner in the bore. The cast iron liner had only recently been replaced so it was decided to reclaim the cylinder by building up the bore rather than inserting another liner.

DATA:

Material — Cast steel — .30 carbon.
Size — 24-in. ID by 5 ft long.

For welding this cylinder a "DS" head was mounted on a CM-21 carriage and an extension arm was built so that the head could enter the full length of the cylinder. Counterweights were used to balance the assembly. A measuring tape was attached to the side of the track so that the head could be easily indexed after each revolution of the cylinder. The cylinder was mounted on four trunnions, one of which was driven by an electric variable speed motor through a reduction gear. See Figures 11 and 12.

Preheat time — 52-man hr (Note: Since this was 85,000 psi tensile material, preheating was carried out during the welding cycle.)
Welding time — 124-man hr (1 welder and 1 helper).
Welding speed — 9 in. per min.
Buildup — ⅞ in., 3 passes.
Rod used — 915 lb of oxweld No. 36, ¼-in. diam.
Melt used — 1150 lb submerged arc.
Welding current — 750 amp D.C.S.P.
Welding voltage — 32 v.

Figure 13 — Welding progress shows three-quarters of the first pass completed. Any excess melt or flux is picked up by a vacuum behind the welding head and the solidified melt detaches itself as it cools and falls into the pan shown in the foreground.

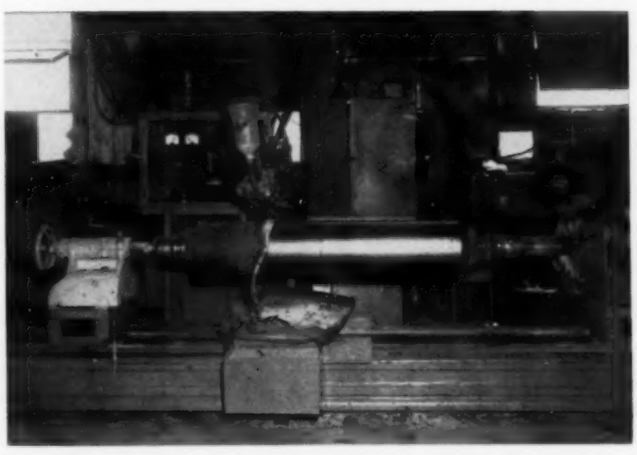
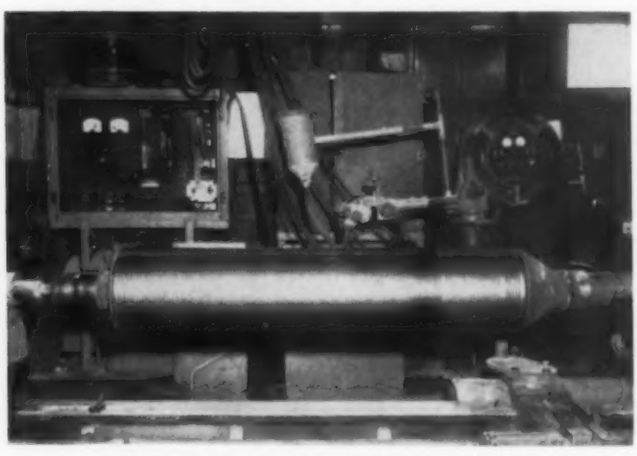


Figure 14 — The finished roll is ready to be machined. The build-up is so uniform that future rolls will not be machined.



REBUILDING A 26-IN. MILL FEED ROLL

A worn 13-in. diam mill feed roll was rebuilt in 29 hr of welding which included preheating. The finished weld was so smooth that it is expected that in the future it will not be necessary to machine the rolls at all and they will be placed in operation in an as-welded condition. See Figures 13 and 14.

DATA:

Material — 0.25 per cent carbon, cast steel.
Size — 13 in. in diam by 6 ft long.
Preheat temperature — 350 to 400 F.
Rod used — 150 lb oxweld No. 40, 3/16-in. diam.
Melt used — 250 lb submerged arc.
Welding current — 550 amp D.C.S.P.
Welding voltage — 32 v.
Welding speed — 18 to 20 in. per min.
Lathe transverse feed — 7/16-in. per revolution.
Total welding time — 29-man hr.
Total set-up and machining time — 27 hr.
Total set-up and machining cost ..... $ 65.00
Total cost of rebuilding mill roll — $137.50 (plus $61.50 for material) or $199.00
Cost of new mill feed roll $1400.00

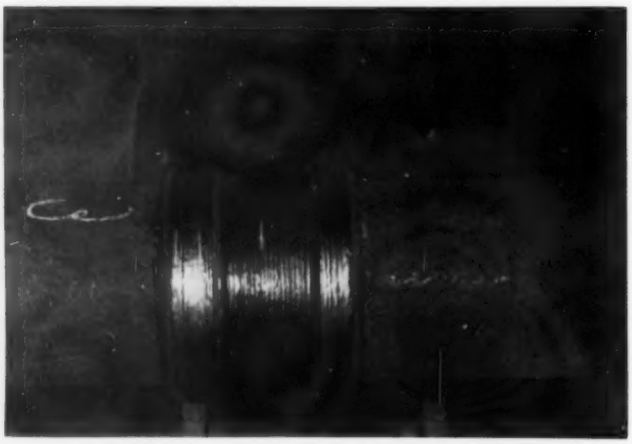


Figure 15 — Spindle is shown after submerged arc welding.

MISCELLANEOUS APPLICATIONS

The following are miscellaneous submerged arc maintenance jobs of which not much detail is on record and which are of interest mainly to show the versatility of the submerged arc welding process.

Rebuilding a steel mill spindle bearing section — Due to a change in design the bearing sections of three steel mill spindles on the stainless hot mill were built up from inside bearing sections to outside sections. See Figure 15.

DATA:

Buildup — From 17 in. in diam to 19 in. in diam with two collars.
Rod used — 400 lb oxweld No. 40, 1/8-in. diam (per spindle).
Melt used — 650 lb submerged arc (per spindle).
Overall time per spindle — 35 man-hr.
Cost of rebuilding per spindle $201.25
Approximate cost of thermite welding each spindle $500.00

Figure 16 — The press ram has been built-up with No. 420 stainless steel.

Rebuilding a 1000-ton press cylinder with stainless steel. See Figure 16.

DATA:

Size of cylinder — 23 in. in diam by 5 ft 4 in. long.
Rod used — 450 lb Type 420 stainless steel, 3/16-in. diam.
Melt used — 675 lb submerged arc.
Welding current — 550 amp D.C.S.P.
Welding voltage — 35 v.

Figure 17 — Columns are fabricated out of mild steel plate using submerged arc welding.

COMBUSTION AND FINE GRINDING WITH THE JET MILL

By G. M. CROFT
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and

L. D. BECHTEL
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Chicago, Ill.

. . . . the jet pulverizer can be applied to almost any industry where fine grinding is required . . . .

▲ THE jet pulverizer can be applied in general to solid fuels for combustion purposes and to the fine grinding of various other materials used in fields such as chemical, building materials, paper, food, and others. The jet pulverizer uses energy for pulverization from superheated steam or preheated air, and where necessary due to temperature control conditions from compressed air at atmospheric temperature or refrigerated air. Usually, air preheated or steam superheated to a total temperature of 750 F is used as the pulverizing medium and the pressure required is around 100 psi gage at the nozzle inlet. Pulverization is accomplished by collision of the particles against themselves instead of against any portion of the mill.

Figure 1 shows arrangement of mill, feed mechanism and power type classifier. The raw material enters the pulverization chamber by means of the feed mechanism and injection jet. Initial pulverization is accomplished by direct impact of the high velocity steam or air jets. This action reduces most of the raw material to fine particle size during the first cycle, and due to their relatively light weight, these particles are carried in suspension from the pulverizing zone up through suitable riser pipes located above the expansion box of each jet to the outlet pipe of the power type classifier. The coarser particles, which fail to be lifted up through the riser pipes, are directed through the recirculating guns for further pulverization. The size of the end product passing out of the material outlet pipe is controlled by the rpm of the power type classified and the amount of strip air discharged into the bottom of the classifier. Particles which are not of the required fineness are returned to the pulverizing zone for additional pulverization by means of the reject hopper.

For positive control of the end product particle size, it has been found that the power type classifier is the most economical and satisfactory piece of equipment for this purpose. The jet pulverizer equipped with a power type classifier can produce a coarse end product, or an extremely fine end product simply by the manner in which the mill jets and nozzles, power separator and strip air are adjusted and controlled. This means that for coarser pulverization, the fluid energy consumption of the mill will be economical in its efficiency and will compare favorably with any type of pulverizer. For the finer pulverization of solid materials, the indications are that the cost of energy for the jet mill will be extremely favorable when compared to other types of mills.

The jet mill is usually equipped with a superheater with its outlet temperature of gas individually controlled. The same superheater will suffice for either steam or compressed air. Where the nature of the material being pulverized will permit it and economy justifies it, it is desirable to operate with compressed air heated in the superheater after compression to a temperature of 750 F total temperature. Heating the air to this temperature boosts the volume of the air to the extent that the compressor load operating the mill is reduced by approximately fifty per cent. In addition to the lower power consumption achieved through preheated air, considerable drying ability is afforded. Heated compressed air will remove moisture from the material being pulverized, and for moisture contents ranging up to eighteen to twenty per cent, compressed air at 750 F will usually dry adequately. Superheated steam at the same temperature will remove a higher percentage of moisture. Thus, the jet pulverizer acts both as a dryer and a pulverizing device. The pulverizer can handle materials with as much as twenty per cent moisture with little or no reduction in capacity. The temperature of 750 F by virtue of increased nozzle velocities pro-

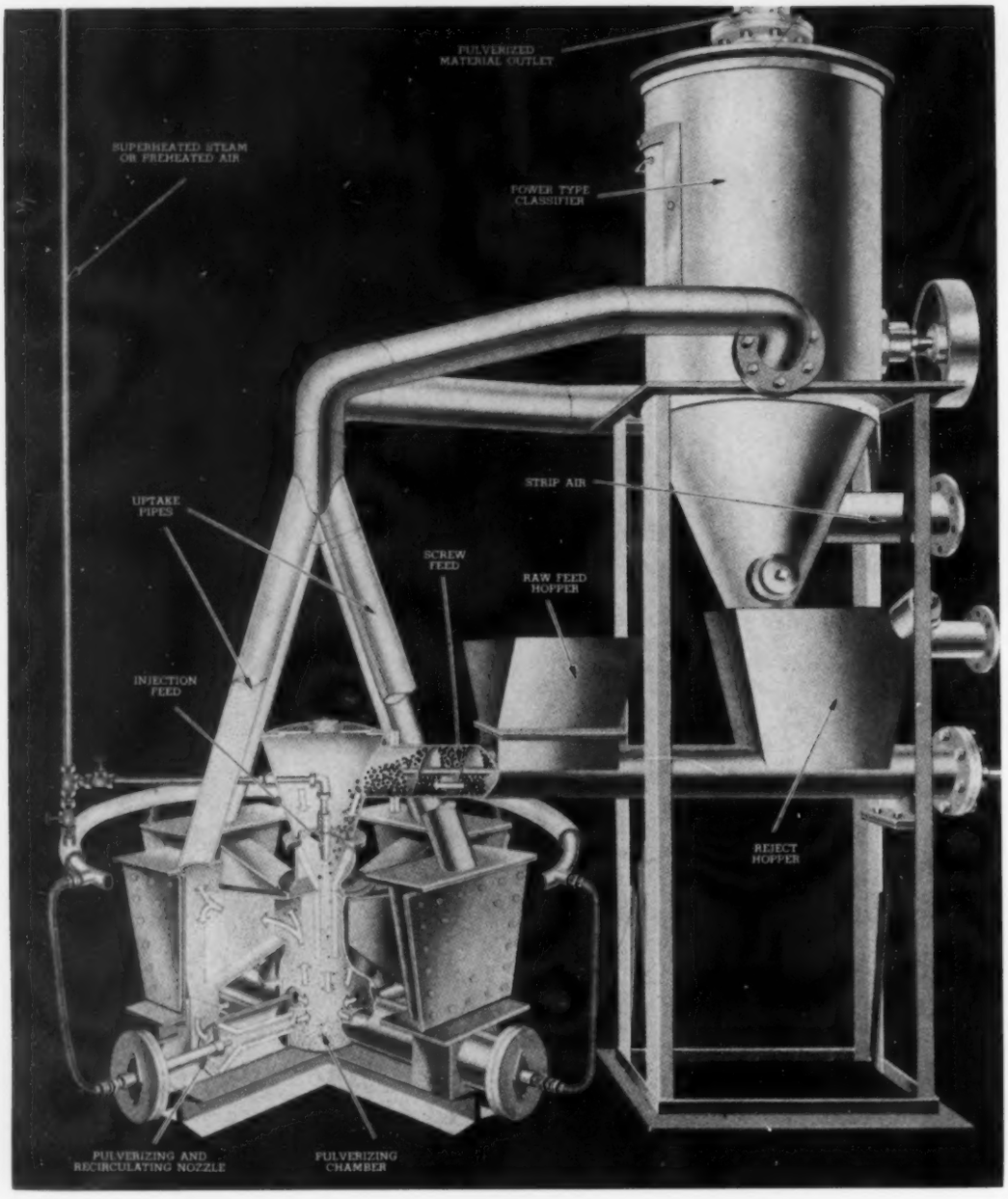


Figure 1 — Diagram shows arrangement of jet pulverizer.

vides impetus to the force of the jet and thereby produces better pulverization.

In general, it may be stated that the use of compressed preheated air or atmospheric air is just as satisfactory as the use of superheated steam for ability to pulverize economically. However, local conditions and the type of material to be pulverized must be studied and considered to determine which gas is most suitable for a particular location.

The jet pulverizer operates free of vibration and with no more noise than experienced with an average fan. If the strip air fan is located, as it can be, at a distance from the pulverizer, there is practically no noise from the unit, itself. No special foundation for the pulverizer unit is required. In all cases of commercial installations, the pulverizers are not even bolted to the floor upon which they are located. This provides a savings as compared to foundations necessary for much heavier equipment.

A unique feature of this jet pulverizer is the absence of moving parts. With the exception of the feed mechanism, which feeds the material from the hopper to the pulverizing zone, there are no moving parts in the unit. This feature reduces maintenance to a minimum, as wear of any consequence appears only in the guns of the pulverizer, and this wear by use of the proper type of metal has been proven, through actual operating experience, to be nominal. For pulverizing normal unabrasive materials, hardened tool steel is incorporated, and for the more abrasive materials, such as coke breeze and garnet, the guns are lined with tungsten carbide.

The degree to which a material can be pulverized in the jet pulverizer may be varied by changing the distance between the face of the guns, by varying the pressure at the nozzles, by varying the amount of strip air, and by varying the rpm of the power type classifier. The jet pulverizer maintains a constant fineness of pulverization and is not subject to a decrease in fineness of pulverization as wear occurs.

USE OF THE JET PULVERIZER FOR COMBUSTION OF SOLID FUELS

For the combustion of solid fuels, the jet pulverizer was developed for the pulverization and economical burning of various grades of fuel, and to enable a more effective use of the large quantities of coke breeze accumulated from the manufacture of coke. The grades of fuel considered were those such as strip bituminous and anthracite fines, lignites, sub-bituminous coals, and the ever increasing fine coal screenings accumulated at the mines as a by-product of recently installed coal refineries.

The jet pulverizer is manufactured in various sizes; the smallest unit developed to date has a capacity of 500 lb of coal per hour and the largest mill is capable of delivering 20,000 lb of coal per hour.

Power consumption is a function of the fineness desired. For a fineness of better than 90 per cent through a 200 mesh U. S. Standard sieve, actual operations with low grade bituminous coal have indicated less than 0.25 lb of steam per pound of coal; and for a fineness of 70 per cent through a 200 mesh and 98 per cent through a 100 mesh, actual operations indicate less than 0.2 lb of steam per pound of coal.

The equivalent power required to operate the jet pulverizer in kilowatts per ton, when using air as the fluid energy, is approximately 16 to 18 kw per ton when the end product is 70 per cent through a 200 mesh screen. When using steam as the fluid energy, the equivalent power cannot be justifiably evaluated in kilowatts per ton, but should be evaluated in increment cost of fuel for producing the steam utilized in the operation of the unit, and to this increment fuel cost should be added the cost of additional feed water make-up necessary for the consumption of this steam.

For the various applications, as in the case of public utilities, the use of steam as the fluid energy should be evaluated against the consumption of electrical current in kilowatts, which is a salable product; whereas in the case of an industrial plant, electrical current is either purchased or generated and the steam consumed in the mill is less in increment cost than cost of electrical current and should be evaluated on an economic basis. In such cases, the plant heat balance should dictate the economic evaluation.

Actual operating experience indicates that by the installation of automatic controls in the jet pulverizer for automatically reducing the pressure on the nozzles with decreased load, economical savings will be obtained in power when operating the pulverizer unit well under capacity.

The rate of steam consumption per lb of coal can be controlled from maximum capacity of the mill to approximately sixty per cent of capacity. Below sixty per cent of the rated capacity of the pulverizer, the steam rate or equivalent power rises slightly, but indications are not as great as the conventional pulverizer units.

The grindability factor of different grades of bituminous coals normally ranges in index factor from 50 to 75. This variation in grindability index factor has no appreciable effect on the jet pulverizer's capacity, on its efficiency, nor its ability to produce the fineness intended. On coals having a grindability index factor higher than 75, the capacity of the pulverizer goes up to some slight degree. On anthracite, with a grindability index factor of normally less than 50, favorable capacities in comparison with bituminous are obtained. Even though anthracite is harder in nature, it is very friable and of greater bulk density than bituminous coal, in general. Therefore, in lb per hour processed in the mill, the capacity on bituminous and anthracite coals will be very close for the same fineness in each case.

In the development of the jet pulverizer for steam generation, it was realized that in a great majority of cases the pulverizer could be applied to existing combustion chambers as well as new ones. Existing furnaces in many cases could not be adapted to conventional pulverized fuel firing which provides a fineness of approximately 70 per cent through a 200 mesh screen.

Experience with the jet pulverizer indicates that a pulverization better than 90 per cent through a 200 mesh screen is practical for combustion and that such fineness of pulverization will have the following effect on the application to steam generating equipment.

1. Permit more rapid burning and, therefore, shorter flame length. This affords the installation of jet pulverizing equipment to many existing furnaces, whereas coarser pulverization would result in longer flame travel and consequent flame impingement on boiler tubes and refractory.

2. Due to the extreme fineness of pulverization, slagging tendencies have been reduced on tubes and walls. This is attributed to more complete combustion of the coal particles and consequent less particle impingement.

3. Fine pulverization permits improved air-fuel mixture, resulting in better combustion with less excess air, thereby reducing stack temperatures and increasing operating efficiencies.

4. Experience indicates that the pulverization of the fuel to a fineness in excess of 90 per cent through a 200 mesh has the effect of reducing the ash particle size to such a small increment that abrasive action on economizers, air preheaters and boiler tubes is substantially reduced and that in many locations it is not deemed necessary to install fly ash removal equipment.

The fineness of pulverization is consistent, and there is no variation due to wear on mill parts or surfaces. Dependable records, which include an accurate record of the amount of coal pulverized by the mills and internal inspection by which all parts were measured accurately, establish a maintenance cost on bituminous coal of 0.727 cents per ton. This is for material only and applies to bituminous coal having a grindability index factor ranging from 50 to 75. Materials used to establish this maintenance, which is primarily on the jets, were a special alloy developed for this service.

The strip air fan supplying strip air to the jet pulverizer can be located in two positions: (1) It can be located on the discharge side of the pulverizer, whereby the mill operates under a minus pressure and all pulverized material from the mill passes through the fan in the conventional manner. If located on the discharge side of the mill, the fineness of pulverization reduces the particle size to such an extent that abrasive action on the fan and the impeller is at a minimum. (2) It can be located on the inlet side of the mill, whereby the mill operates under a positive pressure and the fan handles

only gases with no solid material in it. In this case, there is no possibility of abrasive action due to solid particles, which occurs in the conventional mill.

APPLICATIONS OF THE COMBUSTION FIELD

The fluid energy pulverizers have been successfully applied to a number of industrial power plants during the past three to four years and are operating under rather unusual conditions, as well as consuming various grades and types of fuels. Such installations are now building up a backlog of useful information upon which those interested may evaluate the value of this type of pulverizer.

One of the first applications of the jet pulverizer was to a 400-hp, 4-drum bent tube boiler set eight feet from the operating floor to the center of the bottom drum, originally designed for stoker firing. The boiler delivers saturated steam at 160 psig to the main steam header of the power plant. No heat recovery equipment, either superheater or economizer, was employed in the unit.

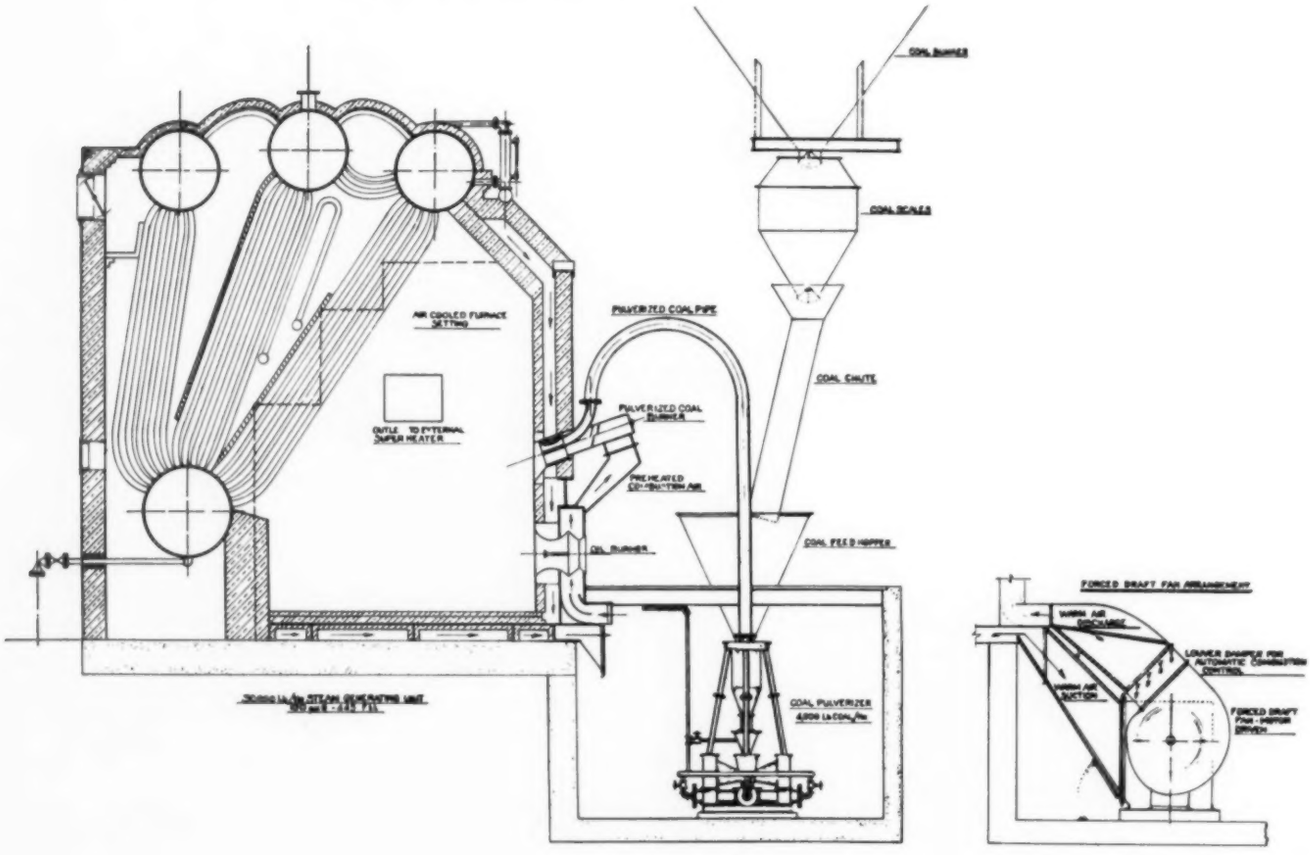
For operating the pulverizer, saturated steam was taken from the main steam header and superheated by means of an external superheater located alongside of the boiler furnace, taking gases direct from the furnace. After passing through the pulverizer, the steam and coal mixture were blown into the furnace through a pulverized coal burner. Air for combustion was furnished by a motor driven forced draft fan and injected at the burner. The furnace was refractory lined throughout; there were no water walls nor air cooling.

ASME boiler tests were conducted to determine the combined operating characteristics of the boiler and pulverizer equipment including the external superheater. The coal consumed was West Virginia $\frac{3}{8}$-in. x 0-in. screenings, having six per cent moisture, six per cent ash, and a heat content of 13,700 Btu per pound. Results of the test indicated a gross combined efficiency of 81.7 per cent with a net combined efficiency of 74.3 per cent. The dust loading in the stack, with no dust collecting equipment installed, was 0.54 to 0.63 gr per cu ft of flue gas emitted, with approximately 75 per cent of the ash from the coal being discharged up the stack. The fineness of the coal pulverized ranged from 90 to 95 per cent through a U. S. Standard 200 mesh sieve.

Another installation was in an industrial power plant equipped with four water tube boiler units, industrial fuel-oil fired with no provision for coal firing nor coal handling. Two of the four boiler units in this plant were converted to a combination coal and fuel oil firing. Each boiler unit was about thirty years old and in good physical condition as a result of carefully controlled feedwater and operating conditions.

The boiler units were four-drum stirlings, bent water tube type of approximately 500-hp each, including superheaters, and three wide range mechanical atomizing oil burners per boiler. Normal operating steam conditions are 150 psig and 80 F superheat.

Figure 2 — Side elevation of jet pulverizer installation.



The furnace setting for each boiler unit was of the air cooled wall type. The only change required was to rebuild the furnace floor to provide proper circulation of air from the side and front walls across the floor to an intake manifold serving a new forced draft fan. Existing automatic combustion control was maintained with only one additional control unit being required, and that was for coal feed, thus providing automatic combustion control for either type of fuel.

By referring to Figure 2, the details of the preceding description may be observed.

With the above in mind, the consideration of the jet pulverizer was investigated and the simplicity of installation alone proved economically interesting. The only revisions necessary to the boiler unit were to provide a hole in the front wall just above the existing oil burners for installation of the pulverized coal burner unit, provide an opening in one side furnace wall for gas flow to the external superheater, and add an extension to the existing wind box at the oil burner installation to serve the coal burner. By referring to Figure 3, burner arrangement may be observed.

This installation may also be observed in Figure 4. This front elevation indicates the relative location of the fluid energy pulverizer units to each boiler, and the shaded areas indicate the pulverized coal pipe, coal burner and additional wind box duct work required above the existing oil burners. In addition, this illustration also indicates the external superheater installation and method of by-passing some of the furnace gases through the external superheater unit. Water cooled dampers were installed between the superheater and each boiler unit in order that if load demands were such as to require operation of only one boiler, the boiler unit out of service could be easily segregated from the superheater operation.

On either side of each pulverizer will be observed the forced draft fan for each boiler unit. The fan pulls air from the boiler room into the top of the air cooled setting, down through the sides and front of the furnace walls, across the furnace floor into the suction of the fan, then discharges it into the wind box through a louver damper automatically controlled. The common wind box furnished air to either the fuel-oil burners or coal burners, and if required, both types of burners may be operated simultaneously.

The coals consumed ranged from a very low grade to an average grade of bituminous. The operating characteristics of each one of the units are, of course, identical; the flame appeared to be a slow rolling radiant type of flame; clear, with little or no clouding in any section of the furnace, and little or no ash deposit on the furnace floor.

The small amount of ash accumulation in the rear pass of the boiler unit indicates that the greatest percentage of ash goes up and out of the stack. Due to the extreme fineness of pulverization, this ash is microscopic in size and dissipates into the atmosphere with no apparent settlement to the local surroundings. Many checks for fly ash deposit have been made, and none could be found even in residential areas within the general locality of the plant; however, this does not mean that the air is not polluted. This plant is equipped with a set of combustion controls, complete in

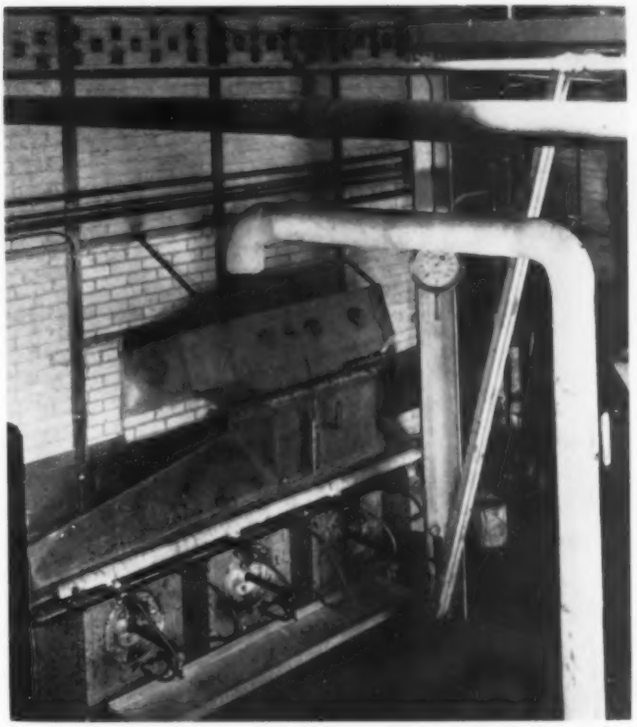


Figure 3 — Coal burner and wind box application.

every respect. Furnace and stack conditions, as far as smoke or color of stack and CO_2 readings of the boiler gases are concerned, were very satisfactory within wide limits of load on the boiler. Stack conditions, from the point of smoke, would pass any of the known existing laws.

From the results of actual acceptance tests conducted upon completion, the average temperature of the steam generated was 440 F, from which the steam required for pulverization was taken and superheated, by means of an external superheater, to an average total temperature of 820 F. The average temperature of the coal mixture from the pulverizer to the burner was 230 F and the strip air temperature averaged 355 F. Average flue gas analysis indicated carbon dioxide at 12.0 per cent, oxygen at 7.0 per cent and carbon oxide at zero per cent. Equivalent evaporation was approximately 8.5 lb of steam per lb of coal when developing 900 hp or 180 per cent of rating. The combined efficiency averaged about 73 per cent, and the furnace heat release was approximately 20,000 Btu per cfhr. The fineness of pulverization, determined from many samples by air flotation method, averaged approximately 97 per cent through a 100 mesh, 94 per cent through 200 mesh and 93 per cent through a 325 mesh screen. At a pulverizing rate of 4,000 lb of coal per lb the unit steam consumption for pulverization averaged 0.38 lb of steam per lb of coal.

In another installation the industrial plant concerned desired to determine by operation of a commercial size jet pulverizer the cost for power and to make accurate determinations regarding maintenance cost on the mill when pulverizing coke breeze. In order to determine these costs, particularly that of maintenance, it was planned to operate the mill continuously on a twenty-four hour basis until sufficient wear had occurred in the mill to accurately determine maintenance cost. For the

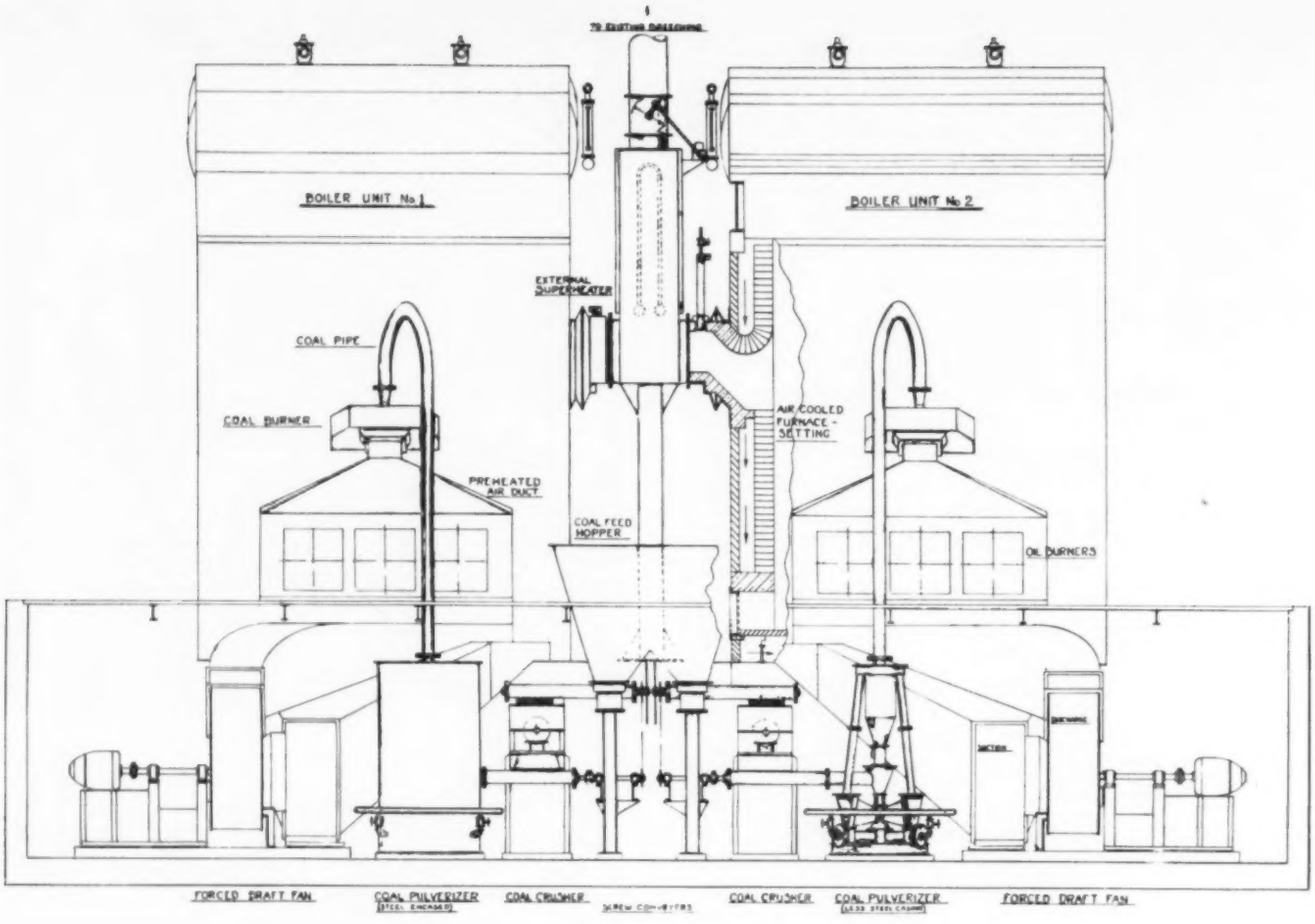
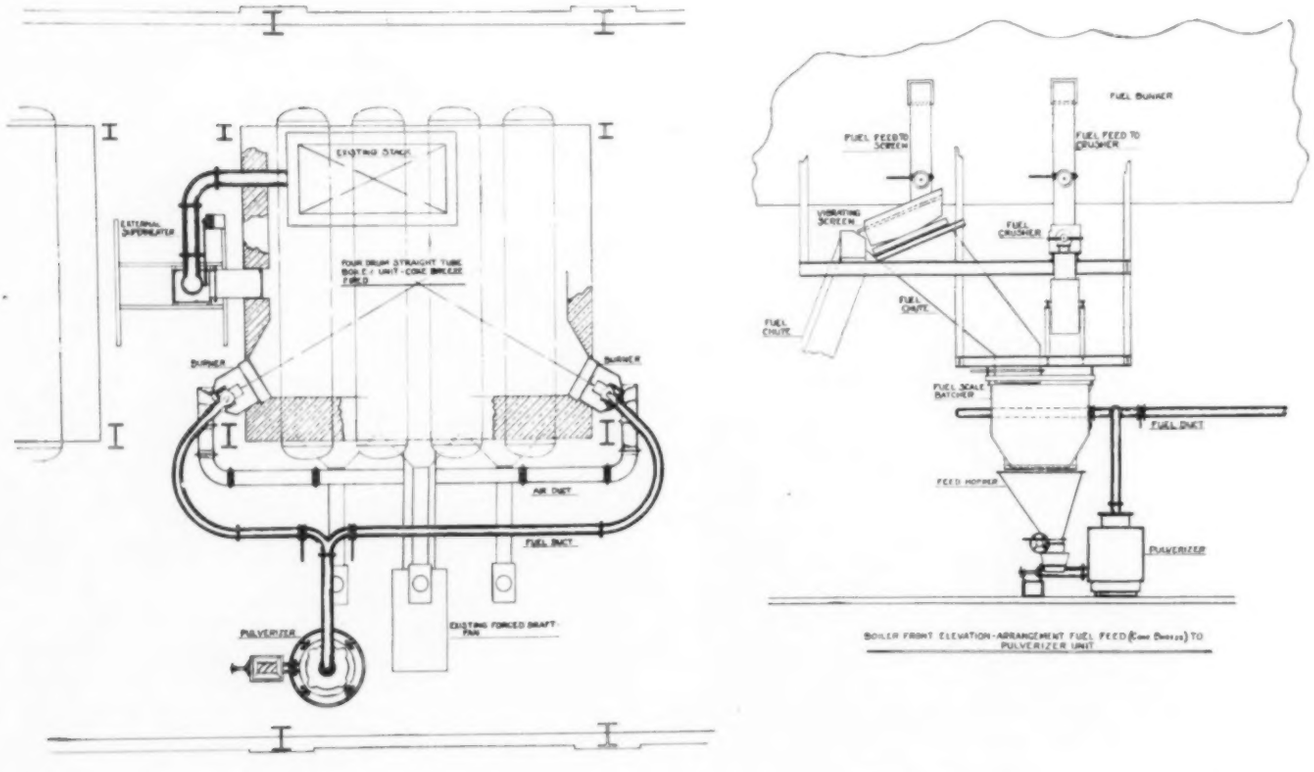


Figure 4 — Front elevation of jet pulverizer installation.

Figure 5 — Plan view shows arrangement of jet pulverizer installation.



purpose of satisfactory disposal of the pulverized breeze during these runs for determination of maintenance cost, it was decided to burn the pulverized breeze under an existing boiler.

Therefore, the jet breeze mill was installed on a horizontal tube four-drum boiler having a rated capacity of 976 hp. This boiler is fired by an underfeed stoker and is equipped with a superheater giving approximately 100 F superheat and an operating pressure of 200 psig. The arrangement of the pulverizing unit was such that it could operate on 100 per cent coke breeze or 100 per cent bituminous coal. End product from the mill, operating on either coke breeze or bituminous coal, was always better than 90 per cent through a 200 mesh screen.

The boiler is also equipped with an economizer and induced draft fan, as well as a forced draft fan. There are no water cooled furnace walls nor air cooled furnace walls. Furnace volume is approximately 3,000 cu ft. Normal operation of boiler with stoker is approximately 200 per cent with a peak of 240 per cent.

Figure 5 illustrates a plan-view arrangement of the jet pulverizer, pulverized coal piping and burners and combustion air for pulverized breeze. It indicates hot gas take-off from furnace to superheater and return of exhaust superheater gases to breeching. It will be noted that the pulverized coke breeze and bituminous coal is discharged from the jet pulverizer to two burners, one located in each forward corner of the furnace and discharging diagonally into the furnace.

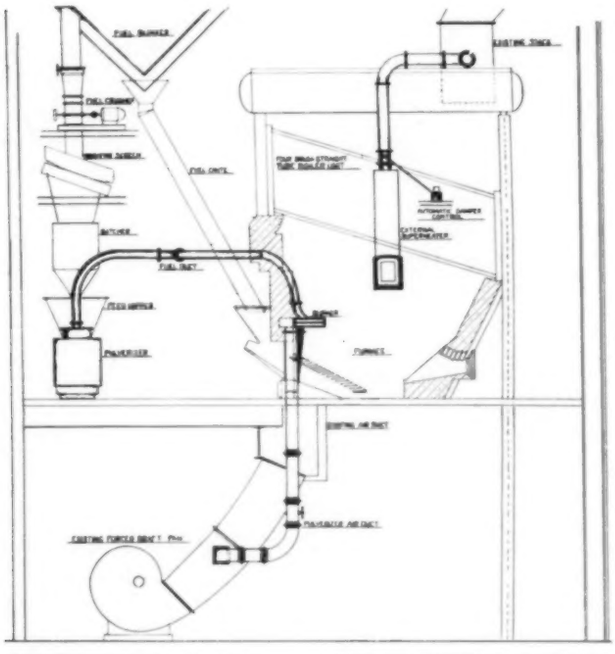


Figure 6 — Side elevation of jet pulverizer installation shows chutes, scale hopper and forced draft fan.

Both burners fire over the bed of the underfeed stoker approximately two feet above the highest point of the stoker grates.

Figure 6 is a side elevation illustrating boiler, pulverizer and forced draft fan, together with the various chutes and scale hopper from the fuel bunker. On this plate it can be seen that combustion air for the pulverized fuel burners is taken from the common forced draft fan feeding air to the underfeed stoker.

Figure 7 — Jet pulverizer application for existing boiler unit.

The capacity of this pulverizer is a maximum of 3,000 lb of breeze per hour, which means that its purpose is not intended to carry the full load placed upon this boiler.

Figure 7 shows the actual installation of the jet pulverizer and shows the pulverizer unit and fuel feed hopper and strip air assembly. This installation is that indicated in Figures 5 and 6.

USE OF THE JET PULVERIZER FOR THE PULVERIZATION OF VARIOUS MATERIALS

Figure 8 illustrates a pilot plant mill for determining the application of the jet pulverizer to the fine grinding of various types of materials.

For purposes of exceedingly fine grinding, the gun design is different and the power type classifier in its relationship to the jet mill is larger to permit more precise control of micron particle size. Depending upon the material being pulverized, superheated steam, compressed hot air or atmospheric air can be used as the pulverizing medium. In each case, the medium used is determined by economics involved and whether the material to be pulverized can stand temperatures above atmospheric. The methods of controlling fineness of pulverization are basically the same as those previously described for pulverizing solid fuels for combustion.

The jet pulverizers for fine grinding can be used in various phases of applications to other materials than solid fuels. Some of these applications are: (1) it can be used for fine grinding or reduction to extremely low micron size of solid friable materials, (2) it can be used for the fine grinding of non-friable solid materials, (3) it can be used for opening up or the defiberization of highly fibrous materials such as wood pulp, asbestos, etc., which is done without breaking up or shortening the fibres, (4) it can be used for the blending of two or three different types of solid materials into an intimate

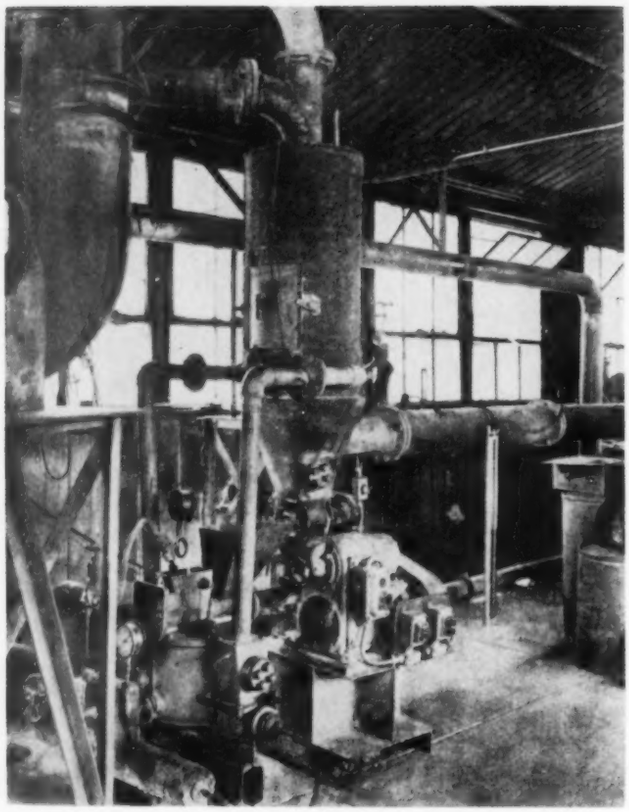


Figure 8 — Pilot plant mill has been used to test fine grinding of various materials.

mixture and can reduce the particle size of the ingredients simultaneously, or it can be operated in such a manner that a thorough blending without reduction in particle size of the ingredients is accomplished, or (5) it can be used successfully for coating extremely fine particles with a chemical or other substance.

APPLICATIONS IN VARIOUS OTHER MATERIALS FIELD

There are cited below some of the applications of the jet pulverizer to other materials than solid fuels. Performance of the jet pulverizer on these materials has been successful and satisfactory for producing the end product required.

1. *Garnet*—Garnet has a hardness on the Moh Scale of between 7 and 8 (the diamond is 10) and is a very abrasive material. The raw feed to the mill had an average particle size of 19.5 microns by Fisher Sub-Sieve determination and the average of the 10 largest particles by microscopic examination was 86 microns. Specifications called for a top particle size of 25 microns with an average of less than 5 microns. End product from the jet pulverizer had an average particle size of 3.5 microns and a top particle size of 20 microns.

2. *HMF Carbon Black*—Particle size of raw feed not known—particle size of end product between 70 and 100 milla-microns.

3. *Mica (Flotation and Jig Micas)*—Extensive tests on both of these types of micas have been made and an end product to meet the specifications was produced. On these materials not only a reduction in particle size was desired, but also a reduction in the bulk density. A typical analysis of the end product would be a reduction in bulk density from 36 to 19 lb and a minimum of 3 per cent on a 100 mesh, 8.8 per cent on 150 mesh, 19.2 per cent on 200, 20.6 on a 325 mesh, and 48.4 per cent through a 325 mesh screen.

4. *Asbestos*—The jet mill defiberized the fibres without decreasing their length and opened up the fibres as desired. By the wet volume method of testing, the raw feed had a reading of approximately 130 cc and the average reading of the end product from the jet mill had a reading of 325 to 350 cc. This fibre was, therefore, upgraded considerably, which increased its value, as normally the wet volume results on fibre from conventional mills average somewhere around 250 cc.

5. *Clay*—Requirements on this material called for a reduction in particle size from a top particle size of 30 and an average micron size of 10 to a top particle size of 10 and an average of less than 1.6 microns. The end product from the jet mill had an average particle size of 0.65 micron to 0.75 micron.

6. *Iron Ore*—This was a low grade ore and specifications called for fine grinding of the ore for beneficiation purposes. A typical screen analysis of the end product from the jet mill is as follows:

Retained 100 mesh	0.4 per cent
Passing 100 mesh— retained 150 mesh	0.4 per cent
Passing 150 mesh— retained 200 mesh	0.4 per cent
Passing 200 mesh— retained 325 mesh	0.4 per cent
Passing 325 mesh	98.4 per cent

7. *Insecticide*—Specifications on this material called for fine grinding to micron size. Raw feed to the jet mill had the following analysis:

Plus 30 mesh	5.1 per cent
Plus 100 mesh	15.1 per cent
Plus 200 mesh	24.5 per cent

The average particle size of the end product from the jet mill was from 2.0 to 3.5 microns.

8. *Plastic* — The particular plastic involved in this case was a cellulosic product and the specifications called for an end product all through 48 mesh with a minimum of superfines. A typical analysis of the end product from the jet mill is as follows:

Plus 48 mesh	0.4 per cent
Plus 100 mesh	10.4 per cent
Plus 200 mesh	49.2 per cent
Plus 270 mesh	17.0 per cent
Minus 270 mesh	23.0 per cent

9. *Fungicide*—Raw feed to the mill had an average particle size of 10 to 20 microns. End product from the jet mill had an average particle size of 2.0 to 2.6 microns.

In addition to the above-mentioned materials, products processed in the jet mill include wood pulp, limestone, calcium silicate, paint pigments, furfural residue, serpentine stone, rubber, silicon carbide, corn starch, fluorspar, cement clinker, and pitch coke.

Experience with the jet pulverizer has demonstrated its ability to not only pulverize fuels for combustion, but also various other solid materials used in industry. In the case of pulverizing fuel for combustion, the pulverized fuel is delivered direct to the burner and when pulverizing other materials, there are different types of bag collecting systems that can be used.

As it stands today, the jet pulverizer is a stabilized piece of equipment and is one that can be applied to almost any type of industry where fine grinding is involved.

SMALL TWO-HIGH REVERSING MILLS
FOR THE ROLLING OF SEMI-FINISHED PRODUCTS

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. . . . the 2-high reversing mill has advantages over the 3-high mill since variable speed is an inherent characteristic . . . . roll changing is easier, operation is simpler and the rolls are stronger . . . .

▲ IN order to get a picture of the status of the 2-high reversing mill, as used for the rolling of semi-finished products in the steel industry of the United States and Canada, an examination should be made of Table I. Shown here are the number of each size of 2-high reversing units, which were being used for reducing ingots on June 30, 1938 and January 1, 1951, as well as the additions and retirements which were made between those dates.

In the group of mills from 18 to 28 in. inclusive, which will be defined as "small" mills, four were added and one was retired between 1938 and 1951. In the group from 30 to 40 in. inclusive, eleven were added and seventeen were retired. In the group of units from 44 to 54 in. inclusive, nine were added and none were retired. A trend is indicated toward reduction of the number of medium size mills, and an increase in the use of small and very large mills. This trend is caused by the tendency to adopt a larger ingot in order to gain operating economies in both the steel plant and the rolling mill departments, as well as to produce larger products, especially slabs. The large units are used for carbon and low alloy steels, and wide stainless slabs, while the increased use of the smaller mills is explained by a corresponding increase in size of ingots of high alloy, stainless, and tool steels, which will be called specialty steels, to the point where the conventionally used 3-high mill and forging hammer or press is uneconomical to operate. It is with this latter condition obtaining in the specialty steel field, that this paper will be concerned, since this is the ideal field of application for the small reversing 2-high mill.

To summarize the production of semi-finished material in the specialty steel industry, twelve 2-high reversing mills, sixteen 3-high mills and two 2-high non-reversing mills are being used, and 20 plants are using forging hammers or presses. Some 19 plants are using both forging and rolling.

There were four small 2-high mills installed around the turn of the century.

In Pittsburgh, the Park Brothers Co. installed a 28 in. steam driven 2-high mill in 1896. This unit reduced a 14 in. square ingot to a minimum billet of 4 in. square. It had no movable side guards for mechanical handling. Turning was done by a lift finger located between the table rolls. Turning of small sections was done by hand. The passes were arranged progressively across the face of the roll, so that turning served to assist moving over. Figure 1 shows a typical pass schedule for this mill, which was the first reversing unit in the specialty steel field. It was replaced in 1925 by a 34 in. 2-high mill.

In 1902, a 26-in. reversing mill with steam engine drive was installed in Western Pennsylvania. This mill handled a 16-in. square ingot of tool steel which was reduced to a 4-in. square of 4 x 2 in. rectangle. This unit is still in operation at the present time.

The mills referred to above were used for reducing blooms of specialty steels. There were installed also two mills for the production of billets for rod and bar mills from relatively small carbon steel ingots. A 25-in. mill installed in the South in 1905 still handles 14 in. square ingots and produces 4 in. squares for reduction to 1¾ in. square billets in a 6-stand continuous billet mill. Three-in. squares are also made for rolling to large finished bars in the billet mill. An 18-in. steam driven mill in the Northeast produced 1¾ in. square billets from 12 in. square ingots of carbon steel for many years, but is now used only for the specialty rolling of non-ferrous products. For carbon steel production, these small units are not popular at the present time because of ever increasing ingot sizes.

TABLE I

2-High Mills for Semi-Finished Products

Size of mill, in.	No. in use on 6/30/38	No. in use on 1/1/51	No. retired between 6/30/38 and 1/1/51	No. installed between 6/30/38 and 1/1/51
Reversing Mills				
18	1	1	0	0
22	0	1	0	1
24	1	1	0	0
25	1	1	0	0
26	0	2	0	2
28	1	1	1	1
30	1	0	1	0
32	4	5	1	2
34	15	12	3	0
35	12	10	3	1
36	9	11	3	5
38	6	4	2	0
40	31	30	4	3
44	13	16	0	3
45	2	4	0	2
46	4	8	0	4
48	2	2	0	0
54	3	3	0	0
Totals	106	112	18	24
Non-Reversing Mills				
20	1	0	1	0
24	1	1	0	0
28	1	1	0	0
Totals	3	2	1	0
Continuous Mills				
40	1	1	0	0
42	1	1	0	0
Totals	2	2	0	0

Since 1938 a number of new installations of small mills have been made. In 1938 a 28-in. mill was started by Rotary Electric Steel Co. in Detroit, to handle 16-in. square ingots of stainless, low alloy, and carbon steel grades. This mill reduced ingots to a minimum of 2-½ in. square. A typical pass schedule used on this mill is shown in Figure 2. It is interesting to note that the 3 and 2½-in. square billets were finished in a series of

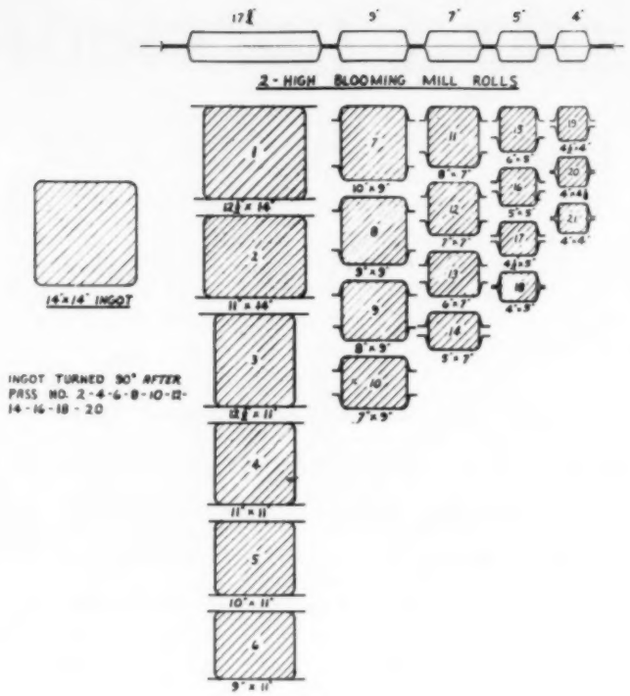


Figure 1 — Typical pass schedule for the first reversing blooming mill used in the specialty steel field.

diamond and square passes. The diamonds were turned up by hand. The 28-in. mill was replaced in 1949 by a 36-in. reversing mill to make slabs up to 40 in. wide and a 4-stand continuous billet mill to make billets down to 3 in. Referring to the manual manipulation of diamonds mentioned above, it is interesting to note that a 32-in. 2-high mill which is now under construction, will have mechanical turnups for both square and diamond pieces. Thus the 2-high reversing mill is becoming more flexible without employing manual labor.

Atlas Steels Ltd., at Welland, Ontario, producing all grades of steel from plain carbon to low alloy, stainless and tool steels, has operated a 26-in. mill since 1941. It works in conjunction with a 22-in., 3-high single stand mill equipped with traveling tilting tables. The mill was originally designed to handle 16-in. round fluted and 14-in. square ingots. However, the present practice includes the regular use of up to 20-in. round fluted and 18-in. square ingots. Also 22½-in. octagon ingots have been rolled. The 2-high mill finishes down to 4-in. square, and also produces up to 16-in. wide slabs, a minimum of 1-in. thick. Preparations are being made to reduce 24 x 16-in. ingots to 19 x 2-in. slabs. The 22-in. mill, which receives the product of the 2-high mill, finishes this product in from three to seven passes, down to 1¾-in. squares and up to 8-in. rounds.

A 26-in. mill similar to the one described above, was installed in 1948 by A. M. Byers Co. in the Pittsburgh district. It blooms for a 16-in. 3-high mill. A 20-in. square maximum ingot is used, although the mill was originally designed for 14-in. square. A small product is required for the 16-in. mill and so the rolls include an oval pass which makes a leader for a 2¾-in. square. An oval turnup device is mounted on the conventional side guard manipulator, and is normally inoperative

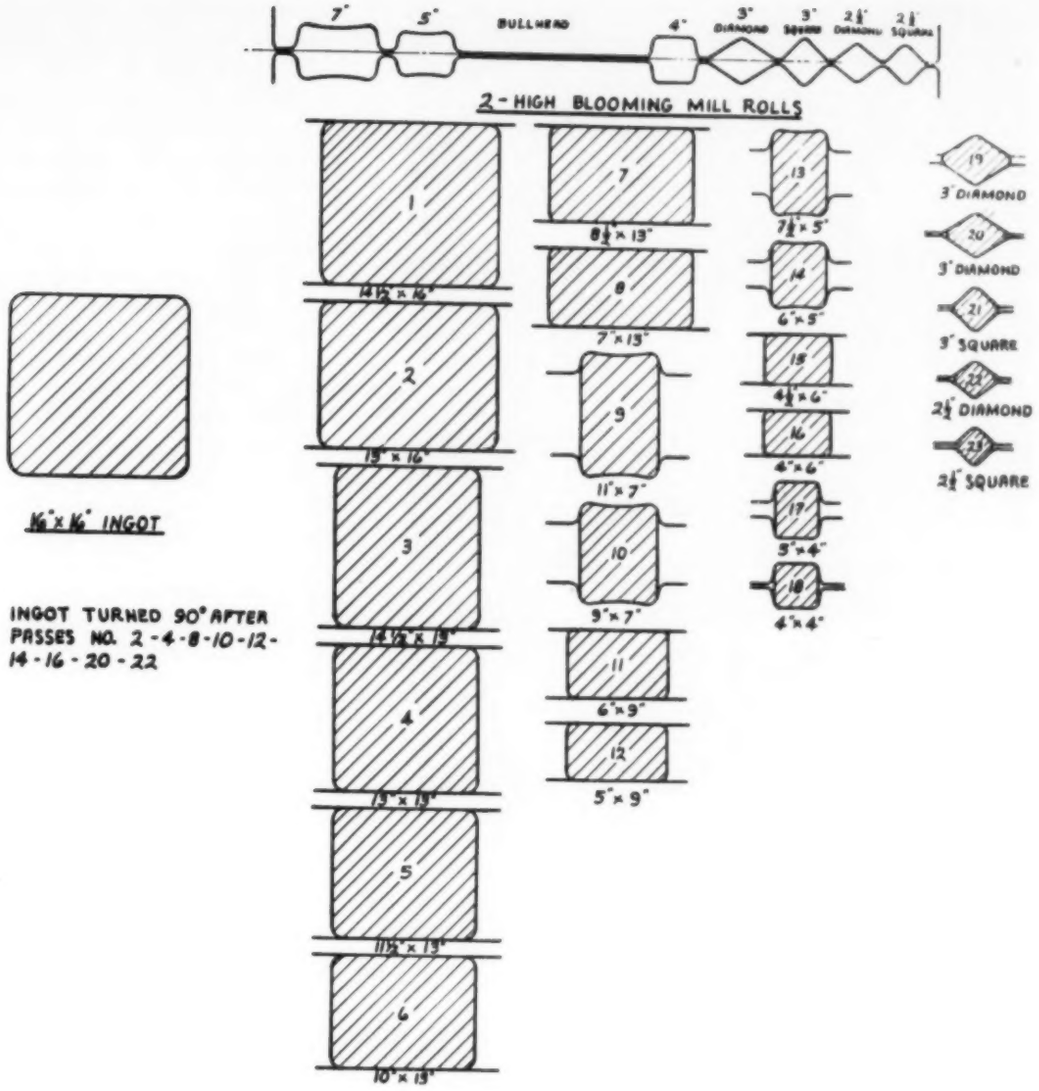


Figure 2 — Pass schedule for 28-in. mill used to handle 16-in. ingots of stainless, low alloy and carbon steels.

and does not interfere with the square and rectangular passes. By the pressure of a foot switch, however, the mill operator can bring the oval turnup rolls into operating position, and then by merely bringing the side guards together, the oval is turned up and held for delivery into the final square pass. The oval pass permits more reduction to be taken than with a box pass, and improves quality by changing the corners into the sides of the succeeding square. With the turnup device it is easier to turn than a long, small rectangle, and avoids the tendency of a small rectangle to turn down in a box pass.

Figure 3 is a view of this mill from the front side. On the near end of the traveling side guard is a housing for the oval turnup. On the 16 in. 3-high mill, in back of the 2-high mill, sections from $1\frac{1}{2}$ to $4\frac{1}{2}$ in. round and equivalent squares are finished in three or five passes. Preparations are being made to finish round billets up to $8\frac{1}{2}$ in., especially for seamless tube rounds, directly on the reversing mill. Guides will be required for the last pass.

At Allegheny-Ludlum Steel Co., Watervliet, N. Y., a 22-in. reversing mill was installed in 1949. A general view of the installation is shown in Figure 4. The top of the mill tables are on the same level as the floor, making for easy access to all points. The mill was designed for a 12-in. maximum square ingot, but is now handling up to 16-in. square ingots and 18 x 12 in. slab ingots. An oval groove for $2\frac{1}{4}$ and $2\frac{1}{2}$-in. square and equivalent rounds, and another oval groove for $2\frac{3}{4}$ and 3-in. squares and equivalent rounds were provided. These ovals are taken by the mill runout table directly to the 18-in. stand where they are turned up and made into a square or round billet in one pass. The rolls in this 18-in. mill also provide for the making of $2\text{-}\frac{7}{16}$, $2\text{-}1\frac{1}{16}$, $2\text{-}1\frac{5}{16}$, and $3\text{-}\frac{7}{32}$-in. rounds made from oval sections produced on the reversing mill. In addition, a 7-in. square dummy hole is provided for passing through 6, 5, 4 and $3\frac{1}{2}$-in. square billets, which are made directly on the 2-high mill. More recently it has been found practical to finish the small square billets, that is, $2\frac{1}{4}$ and 3-in. square, directly on the 2-high reversing mill, as shown in Figure 5. Since a mechanical turnup device was not provided, however, this turning operation must be done manually when it is required. Rounds down to $1\text{-}\frac{23}{32}$ in. have been finished in one

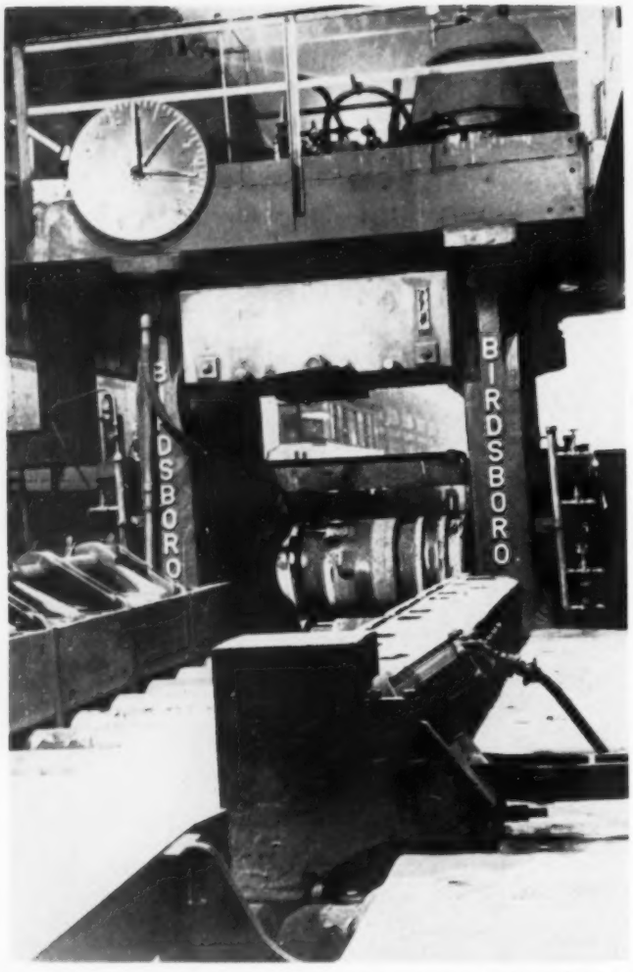


Figure 3 — Front view of 26-in. blooming mill installed in 1948.

pass from an oval on the 22-in. mill by the addition of a rest bar, guide box and roller guides. At this mill, also, preparations are under way to make round billets up to 6½-in. diam directly on the reversing mill by the provision of proper roll grooving, and necessary guides for the finishing pass. An interesting feature of this unit is that it has been operated since its installation by one operator only in the pulpit, a view of which is shown in Figure 6. The controls have been carefully arranged to permit easy access by this operator. Approach and run-out table switches are mounted directly overhead. The mill itself is controlled by a foot master switch, and the screwdown, right and left side guard, front and back mill tables, and finger lift, by master switches located in an approximate semi-circle around the operator's chair.

A 20-in. reversing mill is now being installed to produce billets for a continuous bar mill. This unit will also be arranged for one man operation, but in order to simplify the operation, as well as to provide a maximum of control over the pass settings used, an automatic preset screwdown controller is provided. Use is also being made of master switches with thumb operated auxiliary switches mounted on the handles, to provide control of various auxiliary devices with a minimum of movement of the operator's hands.

An additional 20-in. reversing unit will be installed later this year for use with a combination, rod, strip and merchant bar mill on which alloy, tool steel, and stainless products will be rolled. This mill is designed primarily to be a rougher for the various finishing mills, to break down 4-in. square or equivalent round billets to approximately 1¾-in. square for the rod and bar mills and up to 3 x 11-in. slabs down to ½-in. thick for the strip mill. These slabs will also be cogged from ingots on this mill. It will also be designed for operation by one man, although screwdown control will be manual. An oval turnup device will be provided in the middle of the side guard on the front side of the mill so that oval and square reductions can be used.

An installation of a reconditioned 24-in. 2-high reversing mill will be made by the Green River Steel Co. at Owensboro, Ky., in 1952 to roll 14 x 16-in. ingots and forged blooms for finishing in a new 24-in. 3-high bar mill.

The West Virginia Steel Co. at Huntington, W. Va., will commence operation of new steel making facilities in 1952. A 28-in. 2-high reversing mill stand and motor has been acquired from a previous location and equipped with completely modern auxiliaries. It will reduce 17½ x 18½ ingots of carbon steel to 4-in. square billets.

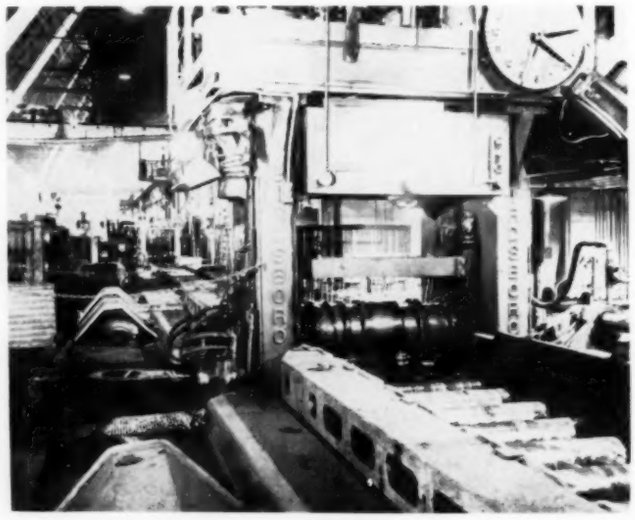
A few mechanical features of the modern small mills will be of interest. All of the mills have water lubricated neck bearings of segmental block design except one, which has tapered roller bearings, and is adjusted axially by moving the operating side chuck only. Roller neck bearings provide ease and accuracy of alignment of roll grooves, plus freedom from eventual misalignment due to thermal expansion and wearing of the end thrust collars, as experienced with water lubricated bearings.

The screwdown motors are arranged for series or parallel magnetic control to obtain two speeds, or with variable voltage control. On these small mills it is practical for the operator to set the roll parting to one-half of 1/64-in. increments.

Mechanical top roll counter-balance is preferred because of the simplicity of its operation and maintenance.

A recent improvement in the lubrication of the universal spindles consists of an oil reservoir with appro-

Figure 4 — Illustrations show 22-in. reversing mill installed in 1949 at Watervliet, N. Y.



priate feed line and metering valve to provide a steady supply of oil to the slippers.

Alloy steel is the usual material used in the rolls for these mills, but iron is required occasionally for better surface conditions. In this case, a removable steel spade is keyed to the end of the roll to provide sufficient strength in this highly loaded section. The 26-in. and 22-in. rolls mentioned above have 66-in. long bodies, while the 20-in. rolls will have 60-in. long bodies.

When a duplex roll changing rig is provided, a complete set of replacement rolls and chucks can be assembled on one of the tables of the rig before the mill is shutdown. After shutdown, the counter-weights are hooked up and the used rolls and chucks are withdrawn as a unit by a screw or rack operated pullout ram. The tables are then shifted, and the same ram places the new rolls and chucks in place in the mill housing. After

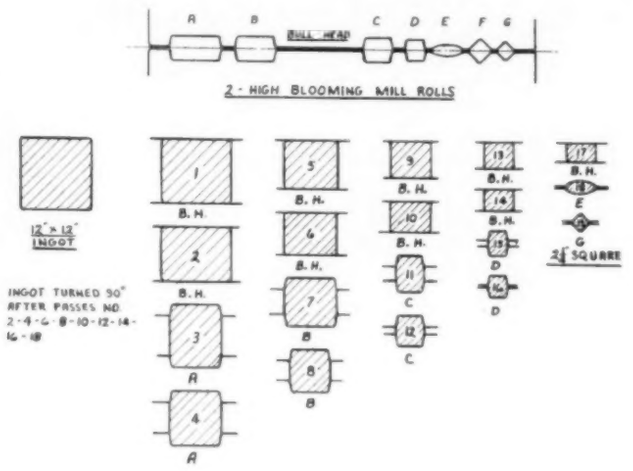


Figure 5 — Pass schedules show manner of finishing small square billets directly on a small 2-high reversing mill.

the mill has started to roll again,the used rolls and chucks can be disassembled and the rolls taken to the roll shop for redressing. Roll changes can be made in 30 min. Simpler arrangements, with a single table and utilizing overhead crane hoist for pulling in and out have also been used, but the changing operation is lengthened to 90 min.

The front and back mill tables have close roll spacing to accommodate the relatively short ingots handled. Self-aligning bearings have been used on roller journals to provide relief from the effect of roll warpage when the ingot heats a roll unevenly, as during a mill delay. Individual feed roll drive is used and two recent installations have incorporated slip clutches in the floating shaft spindle which drives the feed roll, in order to minimize the shock which occurs when a piece leaving the rolls is driven against this roller.

A nest of rollers underneath the mill table carries the manipulator rams, and these rollers are journaled on anti-friction bearings to minimize friction and permit rapid acceleration of the side guards. Finger lift motor and reduction unit can be mounted directly on the side guard, which makes a simple mechanical arrangement and does not slow down the side guard appreciably. The finger lift has a mechanical adjustment

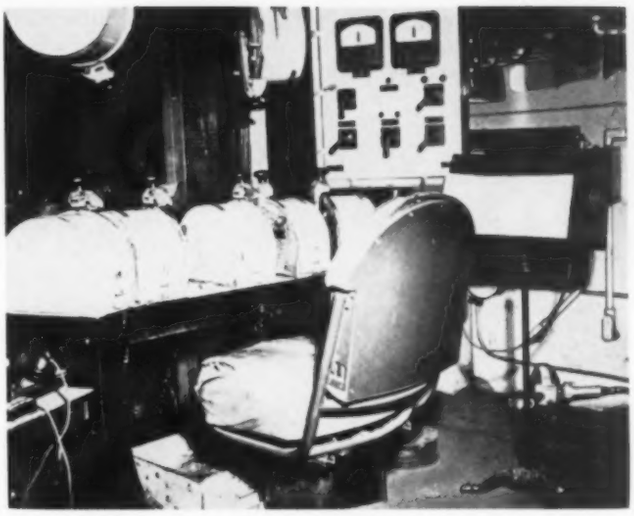


Figure 6 — Controls are arranged for easy operation as shown in the view of the pulpit.

so that different lengths of stroke can be obtained. However, a recent installation accomplishes this end electrically, so that the stroke can be varied to suit the size of product being handled by turning a selector switch in the operator's pulpit. This is a helpful feature when a wide range of sizes is to be handled, since no single stroke will function properly for all of these sizes.

TABLE II

3-High Mills for Semi-Finished Products

Size of Mill, in.	No. in use on 6/30/38	No. in use on 1/1/51	No. retired between 6/30/38 1/1/51	No. installed between 6/30/38 1/1/51
12	4	3	1	0
14	2	4	0	2
15	1	0	1	0
16	8	8	1	1
18	8	6	3	1
19	1	1	0	0
20	3	2	2	1
22	4	5	0	1
24	6	4	2	0
26	1	2	0	1
28	1	2	0	1
29	0	1	0	1
32	1	0	1	0
34	1	0	1	0
35	2	2	0	0
36	1	1	0	0
43	1	1	0	0
46	1	1	0	0
Totals	46	43	12	9

Table II shows the number of 3-high mills, tabulated by size, which were used for reducing ingots to semi-finished products in 1938 and 1951. A tendency to eliminate this type of mill for blooming ingots is apparent.

Since the conventional unit for producing semi-finished products in the specialty steel industry has been the 3-high mill, we will point out some of the advantages of the 2-high reversing mill as compared with the 3-high mill.

We note first that relatively little work can be done in one fixed pass stand. A typical roll design for a 28-in. 3-high mill is shown in Figure 7. The rolls are cut so deep that very little life is obtained, and breakage is always a problem. A 14-in. square ingot is reduced to a 6¾-in. square in these rolls. A typical roll design for a 26-in. 2-high mill is shown in Figure 8. By contrast, an 18-in. square ingot is reduced to 4-in. square in these latter rolls.

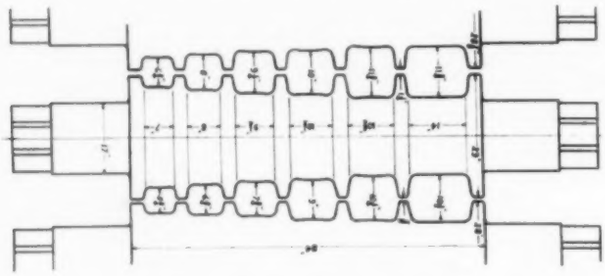


Figure 7 — In 3-high mills, rolls are cut proportionately quite deeply.

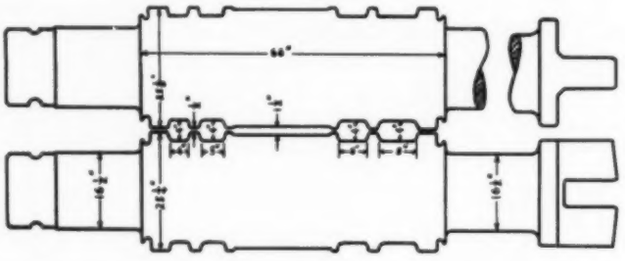


Figure 8 — Grooves do not weaken the rolls in a 2-high mill as much as those in the 3-high mill.

Variable speed is an inherent characteristic of the 2-high mill, and this factor is extremely important in handling specialty steels for the following reasons:

1. Spread may be controlled by varying the rolling speed. Since the spreading characteristics vary considerably from one grade of steel to another, a given series of reductions can be used successfully with different grades and different speeds. With a constant speed drive, such as is usually found on a 3-high mill, difficulty is encountered with underfilling and overfilling as grade and temperature are changed.

2. Difficulty in entering hard or slippery grades can be overcome by entering at low speed.

3. Production can be maximized by taking initial passes at low speed, where entry is difficult, and speeding up on the final long passes. A typical 26-in. reversing mill rolling specialty steel will produce 36 tons per hour of 4-in. square blooms and 50 tons per hour of 5-in. square blooms from 19½-in. octagon ingots. It will also produce 65 tons per hour of 6-in. square blooms from 22½-in. octagon ingots.

4. Slow speeds can be used to avoid rupturing the surface of tender grade ingots, until sufficient work has been done to permit faster rolling.

The mechanical screwdown of the 2-high mill gives the following advantages:

1. Some grades of steel can take heavy reductions and others cannot. Some can stand heavy reductions after they have been worked all over, but must be worked lightly on all sides to break up the ingot structure before heavy reductions are taken. Relatively small orders of these various grades are encountered in the specialty field, and only with the screwdown can the required variations in reduction schedule be made without any delay.

2. Different size ingots must be rolled and numerous different sizes of semi-finished products produced, usually in small orders. Here again the screwdown provides the only practical method to make these size changes without delay.

3. Roll changing on the 3-high mill involves three rolls with necessary chucks, and since the screwdown and counterweights are not available for handling the top roll and setting it in position for withdrawal with the bottom roll through the window, roll changing is usually done by removing the housing caps. This makes for a more complicated and time consuming operation than on the 2-high mill, as well as for less rigid housings.

4. Specialty grades of steel are very apt to develop split ends during rolling. By the skillful use of the screwdown, manipulator, and reversing motor, the operator can save pieces which could not be entered into a fixed pass mill. Other accidents in rolling, such as partial turn-downs, can often be corrected by stopping the mill quickly and working the bar into rolling condition again, an impossibility on a 3-high mill.

5. A mill without a screwdown is virtually useless for the production of slabs, since the edging grooves weaken the rolls excessively. With a screwdown, relatively shallow edging grooves can be used and wide slabs produced. Similarly, the bull head may be used for reducing the minor dimensions of the slabs, whereas the numerous step passes required in a fixed pass mill use up an excessive amount of roll space. Even where step passes can be used, the percentage reductions taken must always be a compromise with the ideal, since in adjusting the rolls to finish different thicknesses of slabs, the percentages of reduction from pass to pass are altered. In the same manner, the diameters of the various step passes cannot be matched correctly.

Entry into the passes of a 2-high reversing mill is always straight. On the 3-high mill with tilting tables, the entry and delivery are at an angle. Improper deformation of the steel, and punishment for the table rollers results, since on the bottom passes the bar runs into these rollers and on the top passes it drops on the table rollers after running out of the mill. If guides are

used, the entry into the guide is poor from the tilting table. Further, the stroke of the tilting table is constant, and it can never be adjusted properly to the roll passes, but must be a compromise with the varying diameters of the middle roll, and the different groove depths.

The side guard manipulator with finger lift, as used on the 2-high mill, is the most flexible manipulating arrangement yet devised. Three-high mills with tilting tables often use fingers located between the tilting table rolls to turn over and manipulate. These arrangements are inflexible, however, and limit the roll designer and operator in their choice of rolling schedule, a very serious drawback in handling specialty steels.

It should be noted also that a fixed pass 3-high mill to handle the same maximum size ingot as a 2-high mill screwdown must be of considerably larger size, as shown in Table III, because of the depth of grooves which must be cut. However, a large ratio of roll diameter to size of piece being rolled increases spread markedly, making it difficult to finish small sizes on a large roll. Since the 2-high mill with screwdown can have a relatively small diameter roll, it is also in a position to finish a much smaller billet satisfactorily.

TABLE III

Maximum Ingot Size Capacity of Small Mills With Mechanical Screwdown and Fixed Passes

Mill size, in.	Maximum square ingot handled, in.	
	Mills with mechanical screwdown	Mills with fixed passes
32	..	16
30	..	15
28	22	14
26	20	13
24	18	12
22	16	11
20	14	10
18	12	9

The relatively large roll of the 3-high mill develops higher rolling pressures and power consumption, and increased strain on necks, chucks, and housings. However, the roll neck cannot be correspondingly larger, because of the necessity of providing adequate support, both up and down, for the middle roll. Because of the limited space between the necks, and between the necks and the housings, it is not possible to provide support comparable to that of the top and bottom rolls of the 2-high stand. For this reason, the passes of the 3-high mill spring more under load, which is a disadvantage if a close tolerance is required on the billet. With some forms of mechanical conditioning close tolerances are required.

It is incorrect to make blanket statements comparing the 2-high reversing mill with the 3-high mill, because numerous refinements of the latter are available, which gain for it some of the advantages of the former. The simple mill, with no mechanical handling equipment or screwdown is still used for cogging specialty steel ingots. However, as larger ingots are adopted, complete manual handling becomes a physical impossibility, as well as a costly luxury. Experience indicates that with high alloy steels, a conversion cost from ingot to semi-finished products of 3¢ a lb, can be reduced to 1¢ per lb by changing from a simple 3-high mill without mechanical equipment to a modern 2-high reversing mill, and this does not make any allowance for the additional savings in the steel plant and in yield due to the possible use of larger ingots. It is apparent that the use of a plain 3-high stand for cogging can be considered economically practical only where very small tonnages of high cost alloys are being produced.

Tilting tables may be added to the 3-high stand to eliminate the hooker. Here again, however, the necessity for dragging over and turning the piece precludes the use of large ingots and still involves high labor costs. A side guard manipulator with finger lift can be adapted to tilting tables to gain some of the flexibility and economy possible with the 2-high reversing mill. Figure 9 shows such a set of side guards applied to a 29-in. 3-high blooming mill used for specialty steels, by Copperweld Steel Co., at Warren, Ohio.

Figure 9—Illustration shows side guards applied to 29-in. 3-high blooming mill at Warren, Ohio.

The mill in Figure 9 also has motorized top and bottom screwdown. The typical arrangement involves a good deal of mechanical gear, and the screwdown mechanism for the bottom roll is especially vulnerable to water and mill scale. In addition, the position of the bottom roll is constantly varied to suit different passes, and so the bottom position of the tilting table cannot be set for proper entry of the piece into the pass at all times.

In order to eliminate some of the objections to the top and bottom screwdown, a 3-high mill with floating middle roll can be adopted, as shown in Figure 10. Here the bottom roll is fixed, and thus can be lined up with the tilting table at the bottom of its stroke. The middle roll chucks are moved between the top roll and bottom roll chucks, either by mechanical linkage connected to the tilting table, or by separate hydraulic plungers. The middle roll support is improved, but the top passes get out of line with the table as the middle roll diameter changes. The use of any tilting table, too, involves

additional control for the operator and more trouble for the maintenance man. With such a mill, however, considerable labor savings and flexibility of operation may be obtained, making it comparable with the 2-high reversing mill.

In view of the preceding paragraphs, it is interesting to compare the cost of various installations. Considering the cost of a 22-in. reversing 2-high mill, with front and back mill tables and side guard manipulator with finger lift, and main drive motor, motor generator set and d-c auxiliary motors, as having a cost of 100, relative cost of 3-high mills with equivalent maximum ingot capacity are given below:

1. A 32-in., 3-high mill, without screwdown and with tilting tables and side guard manipulator with finger lift and a-c constant speed motor has a relative cost of 94.

2. The same mechanical equipment but with d-c variable speed motor and motor generator set has a relative cost of 113.

3. A 22-in. 3-high mill with floating middle roll and top screwdown, tilting tables, and side guard manipulators with finger lift and a-c constant speed main drive motor and d-c mill auxiliary motors has a relative cost of 80.

4. The same mechanical equipment as above, but with d-c variable speed motor, supporting motor generator set and d-c mill auxiliaries, has a relative cost of 97.

The d-c motors in combinations 2 and 4 above, are heavy enough to operate the mill without flywheels. With flywheels, a smaller motor would be practical, and still be possible to set the mill speed from time to time to suit various sizes of ingots and grades of steel. However, the flywheels make it impossible to vary the speed during the rolling of each ingot, and so a valuable advantage of the d-c drive would be lost.

While the reversing mill will do everything that the 3-high mill will do in reducing specialty steel ingots, and will do much of it better than the 3-high mill from a quality standpoint, the same cannot be said with regard to the forging process. Two plants which have recently installed reversing mills have found that about 95 per cent of their specialty grades can be rolled cogged, and at a much lower cost than by forging. However, it is probably true that the forging process will always have a place in the cogging operation, because of the peculiar properties of some of the special alloys.

Reviewing the material presented above, we may conclude that the 3-high mill of simple design has such serious drawbacks for quality and flexibility of production and cost of operation, as to make it impractical for a modern installation. When it is doctored up with mechanical devices, to eliminate labor and add flexibility, it is worthy of consideration only when driven by a-c constant speed equipment. However, progressive mill operators in the specialty steel business are fast coming to realize that variable speed drive on their mills is a necessity for quality and improved production. When the d-c drive is added to the mechanical cost of the complicated modern 3-high installation, with screwdowns, tilting tables, and side guard manipulators, its cost equals that of the simpler and more effective 2-high reversing mill.

DISCUSSION

PRESENTED BY

A. M. CAMERON, Superintendent, Rolling Mills, Atlas Steels, Ltd., Welland, Ontario, Canada

LEWIS W. KING, Manager Roll Sales, Birdsboro Steel Foundry and Machine Co., Reading, Pa.

A. R. FRAME, Assistant General Superintendent, A. M. Byers Co., Ambridge, Pa.

ARTHUR H. GRIFFITHS, Superintendent of Mills, Sheffield Steel Corp., Kansas City, Mo.

ERNEST E. DAVIS, Superintendent Hot Mills, Carpenter Steel Co., Reading, Pa.

A. M. Cameron: I note that Mr. Peterson said they were rolling 1-$^{23}/_{32}$-in. rounds on this 2-high mill by means of a mechanical turner and roller guides. I would like to ask first, are you using a conventional oval leader pass and second, what type of stripping guides are being used?

Lewis W. King: This small guide round has been rolled successfully on one of our mills. However, we do not have the mechanical turning device on this mill and the oval was turned up by hand. It is a conventional single radius oval. The guide equipment is a conventional roller guide box with roller bearings on the entering side. Delivery side no guide.

A. R. Frame: In the opening remarks of Mr. Peterson's paper, he draws comparisons between large, intermediate and small blooming mills, and demonstrates the trend away from the intermediate type. It gives rise to a question in my mind. We have at our plant a 40-in. blooming mill and a 26-in. blooming mill. The 40-in. mill is imposed upon for a considerable tonnage of 4 x 4-in. billets. The 26-in. mill is normally used as a re-cogging mill. However, my question is this. In putting 8000-lb ingots on the 40-in. mill and 5000-lb ingots on the 26-in. mill, both scheduled to go to 4 x 4, what can I expect in the way of relative tonnages?

Lewis W. King: In analyzing Mr. Frame's question, taking the 8000-lb ingot on the 40-in., 2-high reversing mill, reducing it to a cross section equivalent to the cross section of the 5000-lb ingot, which is to be rolled on the 26-in. 2-high reversing mill, and assuming that the same reductions on that section and that 5000-lb ingots are taken on both mills, the 26-in. 2-high reversing mill should roll more tonnage than the 40-in., because it is equipped to roll at higher speeds on the small sections. What ratio of tonnage increase in tonnages would be I am not in position to say. We do not have available data on the tonnages of the larger 2-high reversing mills.

A. R. Frame: In the mills that you have, and that I have seen of that type, I see no finger lift on the delivery side of the mill. I believe it is obvious that with fingers or kickers on the delivery side that numerous

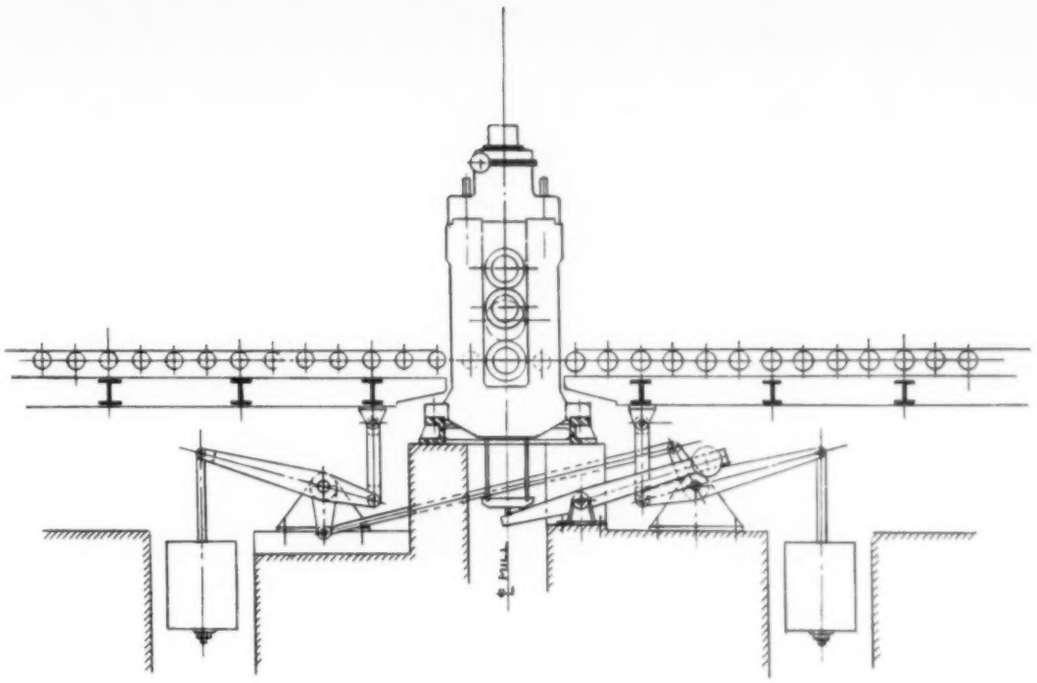


Figure 10 — A floating middle roll eliminates some of the objections to the top and bottom screwdown.

otherwise dummy or dressing off passes could be eliminated, therefore, adding somewhat to speed.

Lewis W. King: It is true that on the 2-high reversing mills at Byers, they do not have the finger lift on the delivery side, only on the approach side. We have manufactured mills with fingers on both sides. The operators of the first one we manufactured are very well satisfied with the fingers on both sides, and tell us they would not like to be without it. We are now constructing another 2-high reversing mill with fingers on both sides, although the original rolling schedule does not call for the use of the fingers on the delivery side, they no doubt will use it in the future, and it is a nice thing to have.

The ideal mill is the mill which has the fingers on both sides which puts your operator in a position to manipulate after every pass and this is probably essential in some grades of special steels. The basic reason that all mills do not have it is the initial cost. Our mills are so designed that we can put the fingers on both sides or say on the delivery side at a later date.

Arthur H. Griffiths: Mr. Peterson mentioned a 32-in. 2-high reversing blooming mill that was going to roll a 5½-in. billet on the diagonal, using the diamond and square method. Will this hold up production? Do you think it should improve the quality of the steel?

Lewis W. King: In answer to Mr. Griffith's question, it is the speaker's opinion that this mill rolling in a closed pass diamond and square and not in the conventional box passes and bullhead pass will improve the surface quality of the blooms.

The production with the reduction rates that they have in this roll design should be approximately the same as having the box method.

Ernest E. Davis: The increasing popularity of the 2-high reversing mill seems to be directly proportional to the increase in versatility of this unit. The 2-high reversing mill has graduated from the strictly production mill, to a production plus quality mill. The skill of the operator or operators plays a big part in the quality angle. This can be controlled, as mentioned, by the use of the automatic preset screwdown controller. Quality can also be further aided by carefully designing the passes in the rolls to obtain a minimum of roll settings for a pass sequence.

In comparing the 2-high reversing mill to the forging hammer, it is well to note that in dealing with specialty steels, the hammer is preferred, in many cases, because the centers of these ingots can be made more solid than by rolling, either by a 3-high mill or a 2-high reversing mill. It should be stated, however, that the use of a larger ingot which is permissible by having a 2-high reversing mill would serve the same purpose.

There were many savings noted by using the 2-high reversing mill. One of these savings mentioned was the ability to melt larger ingots, thus affording a saving in the melt shop operations, and also increasing yields. In line with these savings is another saving which is noticeable in the specialty steel business. Comparing the same size product from two different size ingots as far as surface imperfections are concerned, will show that the product of the larger ingot will require less work to remove these imperfections than the product from the smaller ingot, other things being equal. Thus, the ability to handle the larger ingot would result in a saving in the preparation cost. Or, to put it another way, the same amount of preparation on the two products will result in a better prepared billet from the larger ingot, thus resulting in savings later on in the process.

CONTROL OF DEMAND AND POWER

. . . . if the furnace operator is supplied with the proper instruments and trained in their interpretation, he can operate the furnace more efficiently . . . .

▲ THE control of demand and power factor as applied to the electric arc furnace has been a pertinent problem since around 1917 or possibly earlier. The earlier installations essentially had one voltage for melting and refining, and the kva rating was definitely small compared with what has and is taking place.

Comparatively, an 8 ft 9-in. diam furnace of 1918 was powered with a 1000-kva transformer having a voltage of around 208 for melting and 104 volts for refining. The transformer reactance was 40 per cent. In many cases the power company system required the full 40 per cent to be connected to hold surges within their tolerance. This resulted in a poor power factor as the total reactance would then be in the neighborhood of 60 per cent. This same furnace would be specified with a 2500-kva or even 3125-kva yesterday, although now a transformer is on order for a possible input of around 5000-kva. A smaller furnace had an 800-kva transformer 10 years ago, but now as high as 3000-kva has been applied.

The control of demand and power factor with the multiplicity of differences in the power setup, made it necessary to give specific consideration to each furnace installation in addition to the problems created by the foregoing advance. As a result, a number of devices were brought out, patented and otherwise applied to demand which in many cases resulted in a good power factor as well.

The limited short circuit capacity of the power company system fitted in with low powering in the earlier days to some extent, but again high reactance was usually a requirement. The power company system kept pace or in a good many cases, exceeded the requirement as to short circuit capacity.

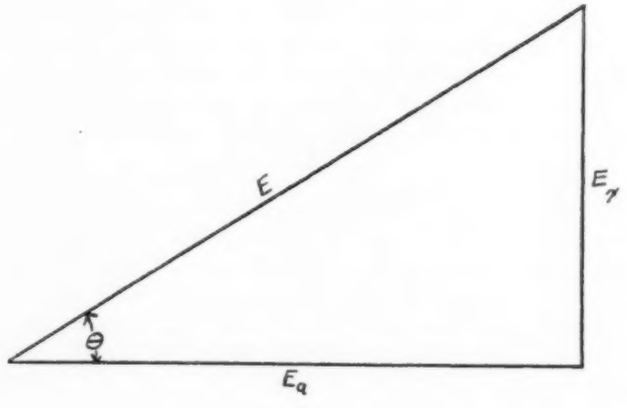
Further, many furnaces were equipped with a limiting device to hold within a top economical demand to keep the power billing at a minimum. Many of the difficulties with these devices and the resulting criticism were due to lack of maintenance. Once installed the furnace owner figured his troubles were over, but any contacting device needs some attention. These devices did not and could not correct for the high reactance required by the power companies to limit the peak of the surges. On the other hand, the power company was not too critical of power factor. Just recently one furnace user was asked to return to the original reactance value and the power factor penalty was waived. Today most power companies are var conscious, and are installing corrective capacitors or synchronous condensers for their own line correction. Until recently only one direct application of synchronous condenser to arc furnace load was in use. By the middle of 1952, three other furnace installations will be so equipped. While their direct application is for avoidance of the flicker problem, the power factor is also improved.

A power factor of 85 per cent indicates a total impedance of 52½ per cent with reference to the primary circuit. From the record of many, many furnace installations, it is apparent that the relation of total reactance to power factor is not well understood. See Figure 1.

$$\cos\theta = \frac{E_a}{E} = \text{Power Factor}$$

For simplicity let us consider the power factor and reactance on the basis of say the secondary voltage side and not consider the ir drop. Suppose E is 130 volts, then E_a to result in 0.85 power factor must equal 0.85 x 130 or 110.5 E_x or the reactive voltage drop must then equal $\sqrt{E^2 - E_a^2}$ or $\sqrt{130^2 - 100.5^2}$ or 68.25 v and for all practical purposes represents the reactive drop in the transformer and secondary circuits. Thus 68.25 volts divided by 130 volts = 52½ per cent total react-

Figure 1 — Graph shows relationship between power factor and voltages.



FACTOR ON ELECTRIC ARC FURNACES

By H. G. HEATH
Electrical Engineer
Pittsburgh Lectromelt Furnace Corp.
Pittsburgh, Pa.

ance. If the current is now increased 25 per cent retaining the same voltage tap and reactance, the 68.25 volts will have increased to 85.25 volts or 65.5 per cent reactance in which case E_a becomes 98 volts. Now 98 volts divided by 130 = 0.75 or 75 per cent power factor. On the other hand a decrease in the current or load will improve the power factor. Suppose 2500 kva at 0.85 power factor, then 2130 kw is the input. Now we increase the load 25 per cent or the kva loading to 3125 kva. If the voltage in use were 130, the power factor is now 75 per cent and we have a kw input of 2350, a gain of 220 kw, but the kva demand has increased 625.

It is hoped that this discussion of power factor will effect a better understanding. So many cases have come to our attention on the disregard of this fundamental that it cannot be too strongly stressed. Economically it is not only operating the furnace at a poorer efficiency, penalizing the owner as to power billing, causing a higher demand on the power company's generating plant, but shortening the life of the transformer when the current is increased over the 85 per cent power factor condition. One company during World War II operated a number of furnaces at close to 70 per cent power factor. On the other hand, if the reactance had been reduced to compensate for the additional load, the 85 per cent power factor could have been maintained.

Coming back to the demand limiting device and assuming that the reactance has been adjusted to obtain 85 per cent power factor at normal transformer rating, and that the maximum kw demand has been set within the desired limit for the period involved, it is in order for the operator to take advantage of any delays at no input, by turning up the rheostat for a higher input. The power factor may drop slightly but the average will hold fairly close to 85 per cent.

Where a number of furnaces were involved in one melt shop, some rather elaborate schemes were worked out to limit the demand, i.e., to stagger the load to keep within a certain maximum demand. In some shops, the melting superintendent generally instructed when each furnace could be melting down on high demand while certain other furnaces were on reduced demand or on the refining cycle. The highly fluctuating load characteristics of the electric arc furnace make it difficult to observe any readings which will make it possible to judge whether the power factor is high or low or just where the demand may be going. When the furnace is installed, however, a series of readings can be taken, curves plotted and a study made that will determine a rheostat setting for a certain demand and power factor. Possibly this study would dictate reducing the reactance or the use of another voltage for the particular furnace condition. Recording instruments giving a graphic picture of the kw demand as well as the vars would seem desirable. The type of scrap and selection of the voltage may not produce the best melting condition for example. Recording instruments would indicate to the operator whether the voltage selected produced high average kw input, or a low var indication that would result a good average power factor.

In the early days due to lack of understanding and the fact that the furnace was generally lacking a wattmeter, the furnaces were operated by current alone. Under such conditions, considerable grief was experienced due to overloading transformers and shortening the life to an early burnout. The current readings should have been used for keeping the phase loads balanced, and a wattmeter provided to indicate the kw input, but it would appear that a wattmeter alone is not sufficient to obtain the most efficient furnace performance at a reasonably good power factor. It was only recently that it came to our attention that one furnace owner by cutting out 5 per cent reactance could operate at 85 per cent average power factor or better. This same customer is installing recording equipment by which he expects to have his furnace operator maintain 85 per cent power factor or better.

Most of the difficulties which we have been discussing and which go with the operation of a furnace occur during the melt-down period. When it comes to the refining period, there is not much to be concerned about as to demand or power factor. One method which has been used during the past two years is to provide means to take the matter of rheostat setting and establishing the kw input to the furnace, away from the operator. This method automatically produces a rheostat setting for each position of the tap changer or voltages which are available for the melt-down. The resistance values in the rheostat circuit are arrived at after a series of readings have been taken and curves plotted to determine the desirable kw input for a good average power

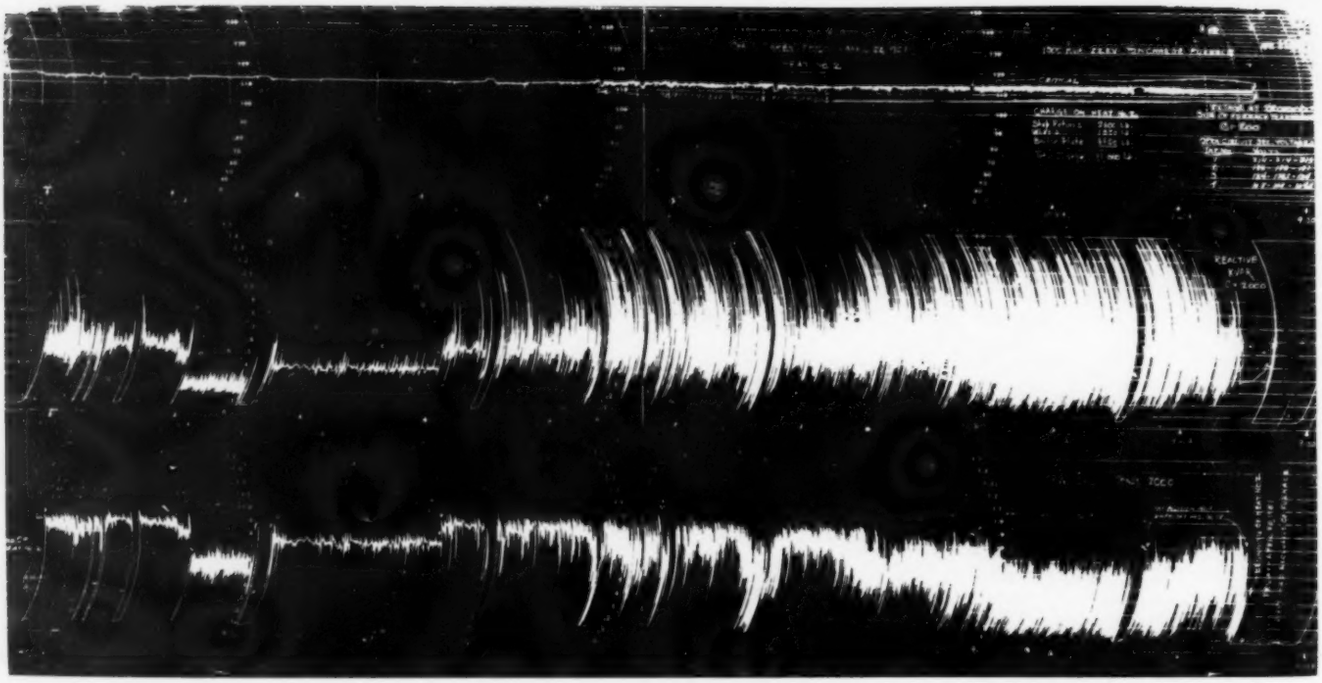
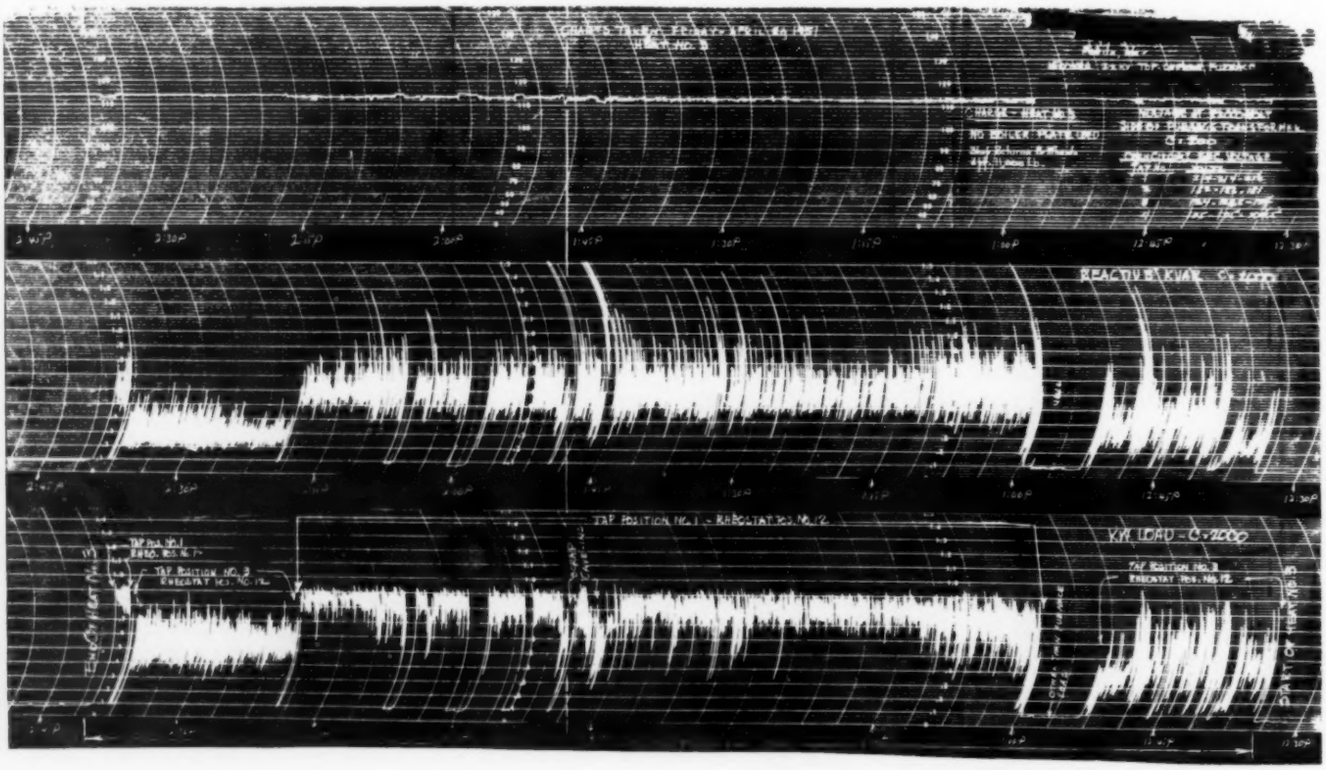


Figure 2 — The No. 2 heat is a good illustration of how a recording watt-meter and a reactive kvar meter indicates to the operator, the wrong selection of voltage resulting in a low kw input at a very poor power factor. In addition, the fluctuation of voltage on the power company's line was intolerable. The furnace operator, had he used a lower voltage on No. 2 heat, could have produced performance comparable with satisfactory kw input, low kvar and a good power factor. This would give support to the use of graphic wattmeter and reactive kvar meter for guidance of good performance to the melter.

factor. As we mentioned previously, however, the furnace may not be operating at the most efficient input by operating the melt-down initially on the No. 1 position or voltage available on that position, but it may be the next lower voltage or even a third voltage that would give the highest integrated kilowatt input for a period of time, say possibly 10 or 15 minutes. The furnace operator has plenty of responsibility. He has plenty of ability. If he is supplied with instruments and some instructions as to the story they are telling, he

Figure 3 — The No. 3 heat shows satisfactory kw input, the reactive kvar is rather typical of good performance and a good power factor. The voltage fluctuations on the power company line were tolerable.



can operate the furnace better and more efficiently than can be done by taking the control away from him.

It is believed that a further study of the problem is justified and undoubtedly a recording type set of instruments is the better solution.

DISCUSSION

PRESENTED BY

CHARLES W. VOKAC, Manager Hydro-Arc, Whiting Corp., Harvey, Ill.

H. H. ANGEL, Electrical Engineer, Construction and Engineering Dept., Bethlehem Steel Co., Bethlehem, Pa.

T. H. BLOODWORTH, Section Engineer, General Control (Electric), Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

A. R. OLTROGGE, Application Engineer, Steel Mill Division, General Electric Co., Schenectady, N. Y.

E. H. BROWNING, Industry Engineering Department, Westinghouse Electric Corp., East Pittsburgh, Pa.

H. G. HEATH, Electrical Engineer, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa.

W. H. BOYCE, Manager, Industrial Division, Delta-Star Electric Co., Chicago, Ill.

Charles W. Vokac: The author mentioned capacitors or condensers for the improvement of the power factor. I would like to question whether or not capacitors are good applications to electric-arc furnaces in every case.

The smaller furnaces, possibly up to 6000 kva, require the addition of reactance into the furnace power circuit to stabilize the arc by offsetting its negative characteristic. This additional reactance lowers the power factor; therefore, it would seem capacitors should be used to raise it. But actually capacitors nullify the effect of the added reactance and bring us back to where we started from.

Larger furnaces energized with 6000 kva or more have an inherent circuit reactance in excess of that required to offset the negative characteristic of the arc. In such cases no additional reactance is added to the circuit; in fact, here capacitors could be applied to offset a part of the inherent reactance and only that part which is not required in the circuit. It is questionable whether any more capacitance in the larger furnaces or any at all in the smaller furnaces would do any good in this respect.

H. H. Angel: In some plants where you have several electric furnaces operating, you may want to cut down your 15 or 30 minute power demand. In doing so, certain arrangements can be made, whereas you may not operate at full capacity as easily. You may start the melt-down time on one furnace, while the other furnace is operating under a finishing condition. I understand there is one control available whereby it is possible to operate at reduced kw input in order to prevent the kw demand from becoming greater than some assumed value you are trying to maintain. I would like to ask Mr. Heath if he knows of very many that are in actual operation in this country, and also what overall results are being had.

T. H. Bloodworth: The marked increase in recent years in number and size of electric arc furnaces—which inherently have a highly reactive demand—has imposed additional demands on power generating and distributing equipment. The urgent demand for steel, especially low alloy steels and electric furnace steels in general, results in operating furnaces at maximum capacity.

Shortage of copper also makes maximum utilization of tie lines and distribution transformers highly desirable. As has been pointed out, power factor of electric arc furnaces loads can be increased by selection of series reactances in smaller furnaces, and careful engineering of large furnace installations to reduce inherent inductive reactances.

By operating at the most efficient input, kwh per ton of steel can in some instances, be materially reduced. The rotating type furnace regulator developed about ten years ago, through its more stable operation, permits furnace operation with less circuit reactance than was previously desirable. The higher furnace load factor (average kw to furnace) during melt-down results in reduction of heat losses and further reduction of kwh per ton of steel.

Control changes to take current control away from the melter are minor and existing controls may easily be modified to incorporate this feature. It is, however, necessary to have an engineer make tests on each furnace during operation to determine the desirable ratio of current to voltage for each transformer tap.

Current control can be returned to the melter by operation of a transfer switch when a variation of the current voltage ratio is desirable. For instance, better operation is obtained on the initial charge of extremely light scrap, by a longer arc and consequently a lower voltage—current ratio. This insures melting sufficient scrap while the electrodes are boring down through the charge to insure an adequate pool of molten metal to protect the furnace bottom.

During World War II, our company installed two 20,000-kva synchronous condensers at one steel company having a large bank of electric furnaces. The resulting improvement in power factor enabled them to add additional furnaces without increasing the size of their incoming power lines, already operating at peak capacity under poorer power factor. Regulating equipment furnished included features for automatic voltage regulation, thereby improving power system voltage stability.

A. R. Oltrogge: I do not think the author emphasized sufficiently the importance of some of his conclusions. For instance, I think the understatement of the year was where he stated that "it would appear that a wattmeter alone is not sufficient to obtain the most efficient furnace performance at a reasonably good power factor." I would also like to reemphasize his concluding remarks where he states, "The furnace operator has plenty of responsibility. He has plenty of ability. If he is supplied with instruments and some instruction as to the story they are telling, he can operate the furnace

better and more efficiently than can be done by taking the control away from him."

Now I am sure most of you fellows are familiar with the experiments at Republic where a significant increase in production was experienced by partially taking control away from the operator. Now in trying to reconcile that experience with what Mr. Heath says, I have arrived at the following conclusion. I think it is a very logical one, and perhaps you will too. It is simply this: If putting a peg in the regulator produces better results than allowing a highly skilled operator to set it, we, or the instruments we provide, are not doing a good enough job of telling that man what is happening in the furnace when he manipulates the regulator setting.

E. H. Browning: Of the topics covered by Mr. Heath, certainly three are of very great importance, either from the standpoint of steel production or from the standpoint of supply of power to the furnace circuit.

One is the matter of furnace circuit reactance. Reactance in regards to electric furnaces must be given consideration in at least two instances. First, a certain definite minimum circuit reactance is a necessity if stable arc operation is to be realized; i.e., enough is needed to prevent the repeated striking and extinguishing of the arcs. When such minimum circuit reactance conditions prevail normally, so do best operating and metal production conditions. For under such conditions, the furnace operator can more nearly cause the kilowatt input to the furnace charge to approximate in magnitude the kva taken from the power supply at or near the rating of the installed furnace electrical equipment. This then means maximum power input and a high power factor. The second consideration pertaining to furnace circuit reactance has to do with the limiting of current surges which occur when charge and electrodes come close together or into contact. If the surges experienced during the meltdown period are severe, voltage fluctuations on the power supply line may be severe unless proper corrective equipment such as synchronous condensers, buffer reactors, etc., are employed. Special attention is presently being given in the planning of a number of furnace installations to the degree of light flicker which may result due to the effects of furnace surges on lighting loads adjacent to or close to arc furnace supply circuits. Particularly is this true where the anticipated connected furnace load is a relatively large percentage of the total generating capacity available. Another reason is that furnace installations are being proposed for location in areas where such loads are somewhat foreign. It is to be hoped that restrictions placed on such proposed furnace installations are no more severe than are actually required. If other factors are definitely favorable, then certainly consideration should be given to available means and corrective equipment for minimizing the effects of the less desirable furnace characteristics.

Another important topic covered by Mr. Heath was that of demand limit control. Where penalties in billing are invoked when an established maximum demand is exceeded, it is mandatory that steps be taken to assure that such does not happen if energy costs per ton of production are to be kept to a minimum. In shops where a number of furnaces are being worked, certainly some method of scheduling should be attempted; however, it is granted that this is difficult, especially when other than high grade alloy steels are being made. Forms of integrating demand limiting equipment used are many and varied. Generally, they do one of the following: indicate incipient exceeding of the demand by sounding an alarm horn such that one or more furnaces can have their loads lessened or dropped; automatically recalibrate the furnace regulators such that operation proceeds at a lower power level; or, cause load to be dropped by automatically tripping one or more furnace circuit breakers. Selective means can and should be provided such that those particular furnaces on refining process are left unchanged.

Regarding optimum current control or optimelt control, there are many furnaces being operated successfully using such control. One large furnace shop has conducted extensive statistical tests and has published results which show a 2½ per cent decrease in energy consumption per ton of steel produced.

Based on results of tests made to determine the best conditions of operation for each tap voltage used during meltdown for a particular furnace, the regulator circuits are adjusted and interlocked with the furnace transformer tap changer such that on each tap voltage used, the regulator is calibrated to give the best operating conditions. This form of control should be considered as an aid to the operator in the obtaining of better production. The operator must still exercise judgment in the selection of the tap voltage used.

Mr. Heath has emphasized the desirability of making recording instruments available to the furnace operator. Such instruments are certainly worthwhile in that they give the operator a graphical running record of the heat on which he is working and histories preceding heats. Proper use of such charts by the operator may permit duplication of like heats in best manner possible.

H. G. Heath: With reference to Mr. Vokac's comments, I think Mr. Bloodworth more or less answered that question. It is true that the arc has a negative resistance characteristic and we must provide reactance, but by due consideration of voltage and reactance for a particular size furnace, and also taking into consideration that there will be some reactance in the power line, we can arrive at conditions that give an 0.85 power factor or better on the meltdown. It will be modified somewhat, but we were trying to emphasize that a particular charge or a particular heat may have to be modified as to the selection of a voltage in order to have a good operating condition and to maintain an average power factor of 85 per cent or better. There can be corrective equipment added in the way of shunt capacitors. We have a number of installations where those are being used, and the power factor of somewhere around 95 per cent is maintained on the power company circuits.

Coming to Mr. Angel's question of how many controls are actually in operation, we might say that on many of the smaller furnaces, you might say individual foundries, casting foundries, that there are a number of demand control devices in use which are holding demand to a certain value, possibly either for a 15-minute or a 30-minute period. Some of these installations have made an appreciable saving, and it was very evident during the depression period that they could still con-

tinue to make castings and make money. Had they not used control of demand and obtained the minimum power billing, they would have been losing money.

It might be said further here that in connection with Mr. Browning's remarks about an optimelt control, in discussions with power company engineers during the last week it was felt that the optimelt control, as far as the power company was concerned, had some advantages. Again, though, it seems that the furnace operator possibly does not have the clear picture as to what he does when he increases or reduces the current. He can increase the current, say 15 or 20 per cent, and naturally reduce the power factor; he may even increase the current to the extent that he will go over to the descending side of the kw input curve as against staying on the ascending side of the curve. The maximum kw input to the primary circuit is at 70 per cent power factor, but he can move back from that point by lowering the current and arrive at 85 per cent power factor which is the logical point of operation.

On the single-phase furnace in the earlier days, quite a number of transformer manufacturers were worried because there was no wattmeter indication on the furnace and the operator was using nothing but current control. In that case, in some instances the power factor was measured at 60 and as low as 50 per cent. The kva demand on the transformer had increased to somewhere around 200 or 225 per cent and they would burn out in about one month's time. In connection with the control of demand there is a definite objection to dropping the load completely, but by a system of relays on the control limiter, the load can be cut back by changing the resistance in the rheostat circuit in order to decrease the load and stay within a certain limit of demand.

W. H. Boyce: I would like to ask one question concerning the comparison of a large quantity of bare electrode cables with a smaller number of water-cooled cables in regard to the effect on the power factor of a furnace. It would appear that in many cases the increase in I^2R loss by the latter would be largely compensated by the decrease in reactance loss brought about by an improved configuration of these cables.

H. G. Heath: There are a number of installations using water cooled cables. On the door charge furnaces they have proven satisfactory. On the top charge furnace, the problem of protecting the hose when the roof swings aside is a problem and the life is shortened appreciably.

The water cooled cable conserves copper. As to the pro and con of decreasing the reactance loss, we believe on the basis that a certain minimum reactance is required, this minimum amount and therefore the minimum loss can be had with the proper selection of voltage for either case.

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SEPTEMBER 28, 29, 30, OCTOBER 1

By JAY J. SEAVER
Jay J. Seaver Engineers
Chicago, Ill.

Cleaning Industrial Gases

. . . . constant progress is being made in the design and economical operation of equipment for cleaning industrial gases . . . .

▲ GAS may be defined as an aeriform fluid, having neither independent shape nor volume, but tending to expand indefinitely. Those which will be treated in this paper are blast furnace and open hearth furnace gases. Cleaning these gases involves the removal of solids from them. Solids in gases are usually spoken of as dust and fume. There is no exact dividing line between these two types of solids, except that dust may be considered to be made up of the larger and heavier solids, while fume consists of the smaller and lighter solids.

Methods for cleaning these gases will be the dry, wet and electrical precipitator systems, or a combination of them all. Under the dry system, units such as the dust catcher, whirly, baffles, deflectors, dry electrical precipitator and bag house would be classified. Those of the wet system would include sprays, gas scrubbers, fans, disintegrators, eliminators and wet electrical precipitators.

The subject of gas cleaning is not new, but due to the fact that its ramifications have multiplied over the years, makes it still a very live one. At first, cleaning the gas involved only the removal of solids from it. Now, it includes the disposal of the removed solids, to keep them from polluting the streams, and treatment of the waste gases to keep them from polluting the atmosphere. These two added requirements are receiving as much thought and attention today as the removal of solids from the gas did, only a few years ago.

In the early days, the blast furnace was operated with an open top, this allowed the gas to go out to the atmosphere, where it burned continually as a flare and lighted the whole countryside. A valve, or large bell, was added to close the top, then the gas flare was intermittent, and burned only when the bell was opened. In order to ignite the gas at each opening of the bell, a lighted salamander usually hung on the gallows frame, which ignited the gas and kept the top filling men from being gassed.

At first, little consideration was given to the heating value of the gas; but after the bell was added, the gas was used to heat both hot blast stoves and boilers. This proved to be an economical move, and as competition was beginning to be felt, utilization of the gas had to be made to keep the operation a profitable business.

These hot blast stoves and boilers were placed at a high elevation, above the furnace top level, so that the hot gas, being lighter than air, would flow up to them with a draft stack effect. Only a few years ago, several of these furnaces, located at Hokendauqua and Alburtis, Pa., were torn down. These furnaces were built of stone masonry, on a side hill location, where the ore was hauled to the furnace top and dumped from two wheel mule carts. Both of these plants were constructed with stoves and boilers above the furnace top and used the gas as above indicated, as it was believed that the light gas could not be brought down to yard level.

The pressure and air volume on these furnaces was quite low, so that only a small amount of dust was carried over in the gas. Shortly after this, however, a steel pipe, known as the downcomer, was connected to the furnace top and the gas brought down to yard level, where it was used in the boilers and pipe stoves at this location.

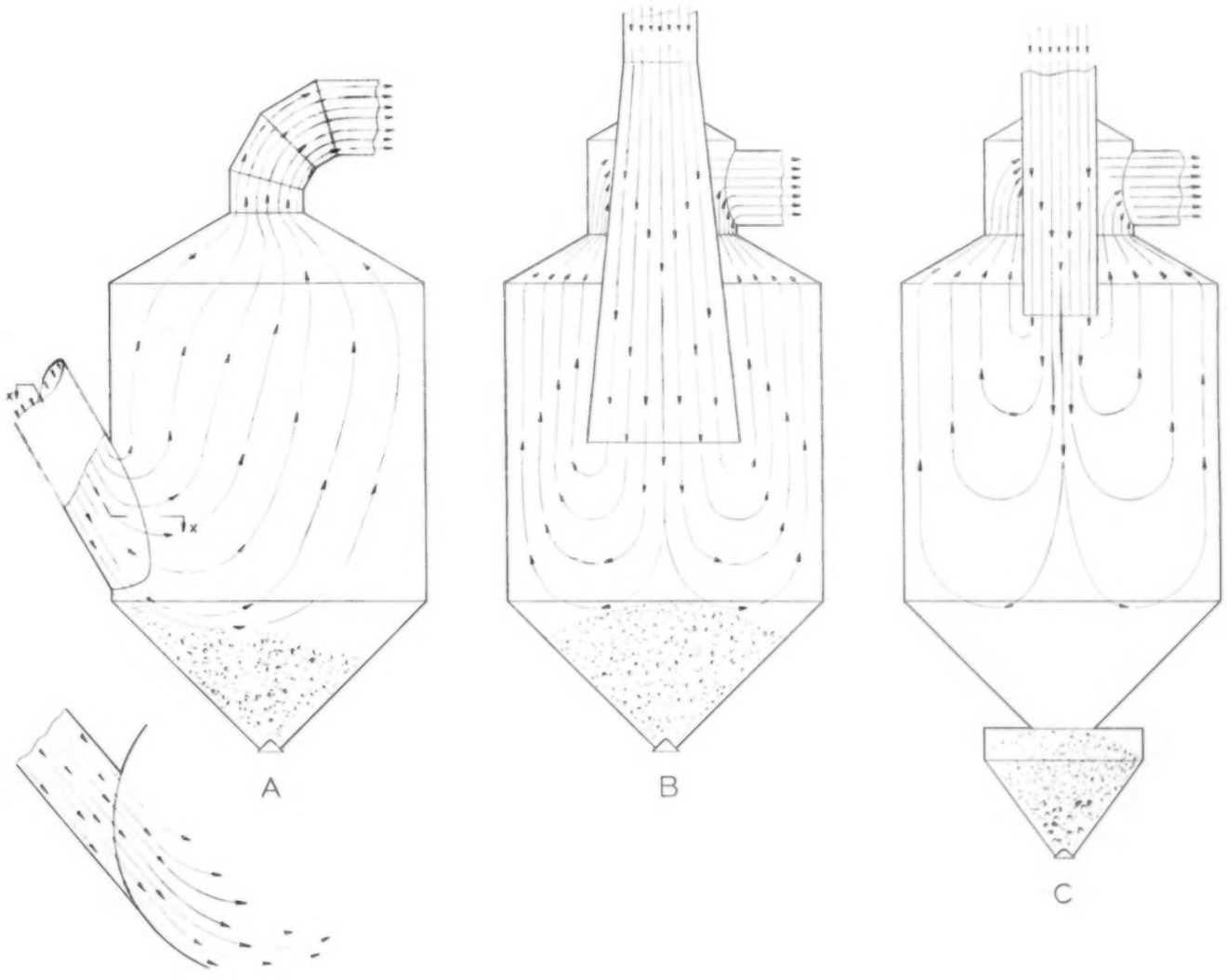
Soon after this, demand was made for more tonnage, which required increased furnace pressure and air volume, with a similar increase in gas volume and solids carried in the gas. To catch these solids, an enlarged section was added at the lower end of the downcomer, known as the dustcatcher. Here, the hot dry dust was collected and discharged on the ground at regular intervals, then hauled away to the dump with a horse and cart. It was not long, however, before still greater tonnage was demanded, with a similar increase in volume of air and gas, and solids carried over. To meet these conditions, the dustcatcher was gradually increased in size, until its practical limits were reached, without satisfactorily cleaning the gas, the efficiency being only 40 to 50 per cent.

This started a series of changes on the dustcatcher. These changes included bringing the downcomer connections in tangentially to the shell with a top discharge, and also, providing a top inlet which terminated into a single flaring internal discharge pipe with a dog house and outlet on top. This latter change required the gas to gradually expand and turn 180 degrees for exit. Both of these changes improved the efficiency of the dustcatcher, but in each case, the incoming gases were inclined to pick up the solids already deposited and carry them out again with the gas stream. To correct this condition, an hour glass dust receptacle should be attached to the bottom of the dustcatcher, so that the solids once deposited, are entirely out of the gas stream, and remain there until the receptacle is dumped. This design is shown on Figure 1.

After and during the time the above developments were being made and used, further demand for cleaner gas, lead to the design and use of secondary dry cleaners. These secondary cleaners were of several designs with varying efficiencies. Those developed first were generally of the centrifugal type, with a side inlet and a top outlet. The design of this type which gave highest efficiency and met competition longest for cleaning blast furnace gas, was the vortex collector. It removed a high percentage of very fine solids from the gas, but it also had some disadvantages. Space was usually limited, so that only one unit could be installed per furnace. If the blast furnace was materially enlarged beyond its original size, the vortex was too small, as it had only a 20 per cent efficient increase capacity range. The very fine dust collected was difficult to handle and the lower end of the vortex collector was subject to excessive wear, due to the high gas velocity and abrasion. However, the vortex collector does remove 250 to 325 mesh solids with an efficiency range of from 60 to 85 per cent, as checked by some of these units still in use.

Another dry gas cleaning unit developed about this time was the bag house. This consisted of a series of vertical cotton bags, closed at the top and suspended from a shaking mechanism. The lower ends into which the gas entered, were open and it gradually filtered through the bags, leaving a deposit of solids on the inside. When a certain differential pressure was reached, the gas was shut off, the bags rapped, and clean gas was blown through the bags in the reverse direction. Each cleaner consisted of a number of compartments, with only one being taken out of service at a time. This

Figure 1 — The three sections show three stages in the design of dust catchers.



cleaner gave a very high degree of cleanliness, approximately 0.005 gr per cu ft of gas. However, it had many disadvantages, due to the fact that the entering gas had to be cooled to about 225 F to keep the bags from scorching. It was very expensive and delicate to operate, while the bags needed constant attention to keep them from clogging. No large installations for blast furnace gas have been made in this country, but small units for other gases are being used here now.

A dry cleaner developed along with others was one which used steel wool as a filter medium. This wool was made up into mats about 12 in. thick, and these were placed in the cleaner in a horizontal position. These cleaners were made up of compartments with a mat in each. The gas flowed up through the mat, until it was filled with solids, then it was automatically cut out and shaken. Several of these cleaners were installed, but none exists today, as the capital and operating cost was too high for the results obtained.

Wet gas washers followed the period of dry cleaners. These washers, which were once considered as finished cleaners, and are now used in most cases as a secondary cleaner, have gone through a series of changes. Originally, wet washing was done by spraying water into the gas mains, which produced a sludge that could not be removed. This led to the impingement type of wet gas washer, where the gas was forced down through tubes, or around a division plate against a pool of water. Several of these washers were built and used, giving a gas cleanliness of 1 to 2 gr per cu ft of gas cleaned. The gas contained a high percentage of moisture and produced a heavy sludge at the stove and boiler burners. It then became very evident that the water should be broken up into a fog, in order to make close contact with the dust particles. Many different washer designs followed, most of which consisted of a vertical cylindrical shell with conical top and bottom. Several of the early washers had only one bank of wooden hurdles, which reached from top to bottom, with large open flues and one manifold with sprays over the hurdle bank. Others used rotating rain makers in the top, and one popular design used a large vertical shaft through the middle, to which was connected several conical spinner pumps. The lower end of the cones projected into pan of water, and as the cones were rotated, a film of water was produced near the upper edges, through which the gas passed. Inside of the shell and opposite the upper part of the cone, conical skirts were provided to direct the gas into the continuous water film at and near the cone top. If this horizontal open space was small, it gave good cleaning and high pressure drop, if it was large, the pressure drop was less with poor cleaning. Consequently, a compromise had to be made between cleanliness and pressure drop. All washers of this period produced gas with a cleanliness of about 0.3 gr per cu ft. Present gas washers are approaching a standard pattern for the various types, except for some details. Those in general use now are a modified mechanical spinner type, one with wooden tear drop hurdles and another with special ceramic spiral tile hurdle banks. They all clean the gas to about the same degree of cleanliness of 0.1 gr per cu ft of gas and are considered to be secondary cleaners. If moisture eliminators are used in connection with them, a higher percentage of moisture and dirt is removed.

Figure 2 — Section through gas washer and moisture eliminator.

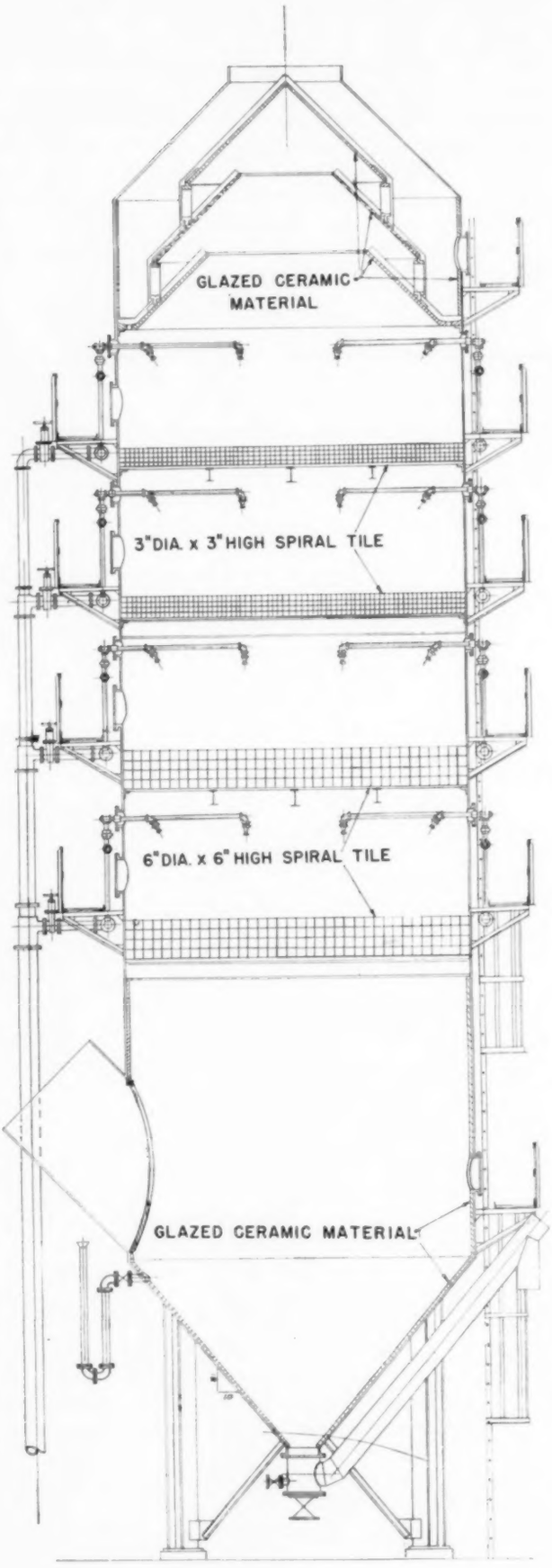


Figure 2 shows the design with special spiral ceramic tile hurdles and eliminator section in the top. In this design, the gas enters at the bottom and passes up through four banks of special spiral tile. Each tile has five holes (Figure 3) through the spiral, one in the center, and four just inside the shell as shown. This permits part of the water to pass through and thoroughly wet the under side of the spiral and inside of the tile, where the gas first impinges. The result is a greatly increased wetted surface for the gas to scrub against, giving thorough and complete washing of the gas. For each vertical foot of tile height, the gas is required to travel 1½ ft against the spiral. Over each hurdle bank is a set of stationary sprays, which cover the entire tile area. After the gas is completely wetted and scrubbed through the four tile banks, it then passes up and rubs against a large exposed area of the ceramic eliminator and is caused to make abrupt angle turns to the exit. The moisture in the gas is collected in drops and drains to the inside of the washer shell, out of the gas stream. This gives dry clean gas of 0.07 gr per cu ft of gas, or better. This washer requires about 3 sq ft of area for each 1000 cu ft of gas cleaned per minute, with about 3 in. of water column pressure drop through each bank of tile. The bottom cone and lower cylinder are lined with glazed ceramic materials, which prevent barnacles from forming on the inside.

In this gas washing period, a horizontal washer consisting of a rotating drum with helical vanes attached to the outer surface of the drum was developed. This washer was usually preceded by another washer and followed by an eliminator. The gas cleaned by this washer was 0.01 gr per cu ft and was generally used for gas engine service.

As the gas washer approached its limit for cleaning the gas, other requirements and uses were making further demand for better cleaned gas. These demands came for use in small checkered stoves, soaking pits, open hearth furnaces, boilers and coke ovens. This led to the development of the electrical precipitator and disintegrator with an eliminator to clean gas for these uses. About 1928, a vigorous competitive campaign was put on by engineers and manufacturers of this equipment to produce gas cleaned to 0.005 gr per cu ft. The dry plate precipitator was developed first, and finally followed by the wet tube type. The wet precipitator is the design generally used today for cleaning blast furnace iron gas, as it has many advantages over the dry type for this service. The disintegrator, which was developed at this time, is a horizontal machine with a series of stationary and rotating bars through which the gas passes, where it is sprayed with water. The water is beat up into a mist and wets the dust particles. Following the disintegrator is a moisture eliminator consisting of a shell and eliminating bank of rashig rings, or coke, for the removal of moisture and dirt. At the beginning of the fine gas cleaning era, disintegrator installations seemed to take the lead; but now the trend is more toward the use of electric precipitators for cleaning iron gas.

Cleaning gas is like trying to approach infinity, there is no absolute end. It simply becomes a question of where you want to stop and the economy of cleaning to the cleanliness desired for particular uses. Cleaning

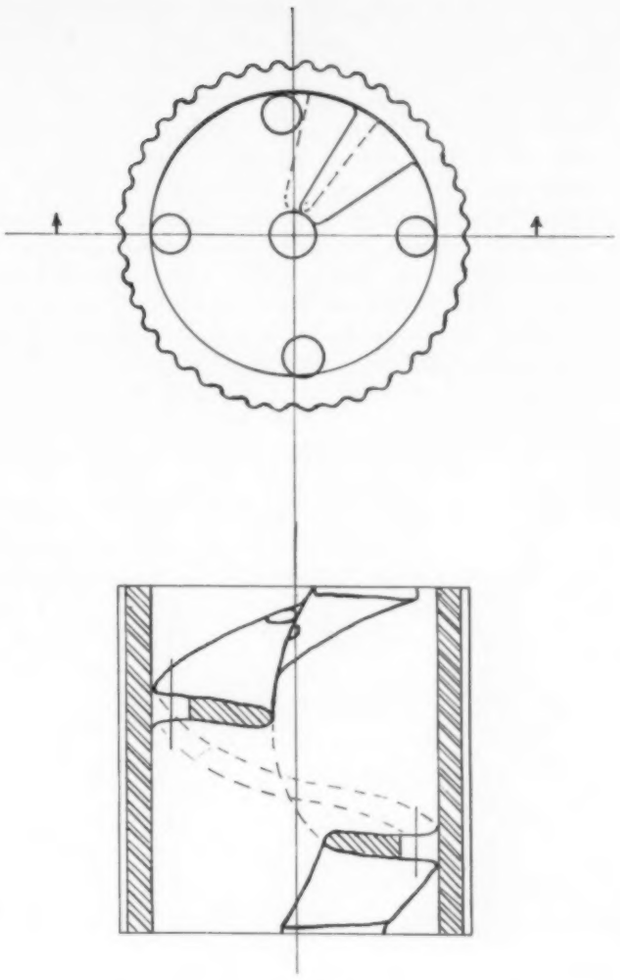


Figure 3 — Improved ceramic spiral tile.

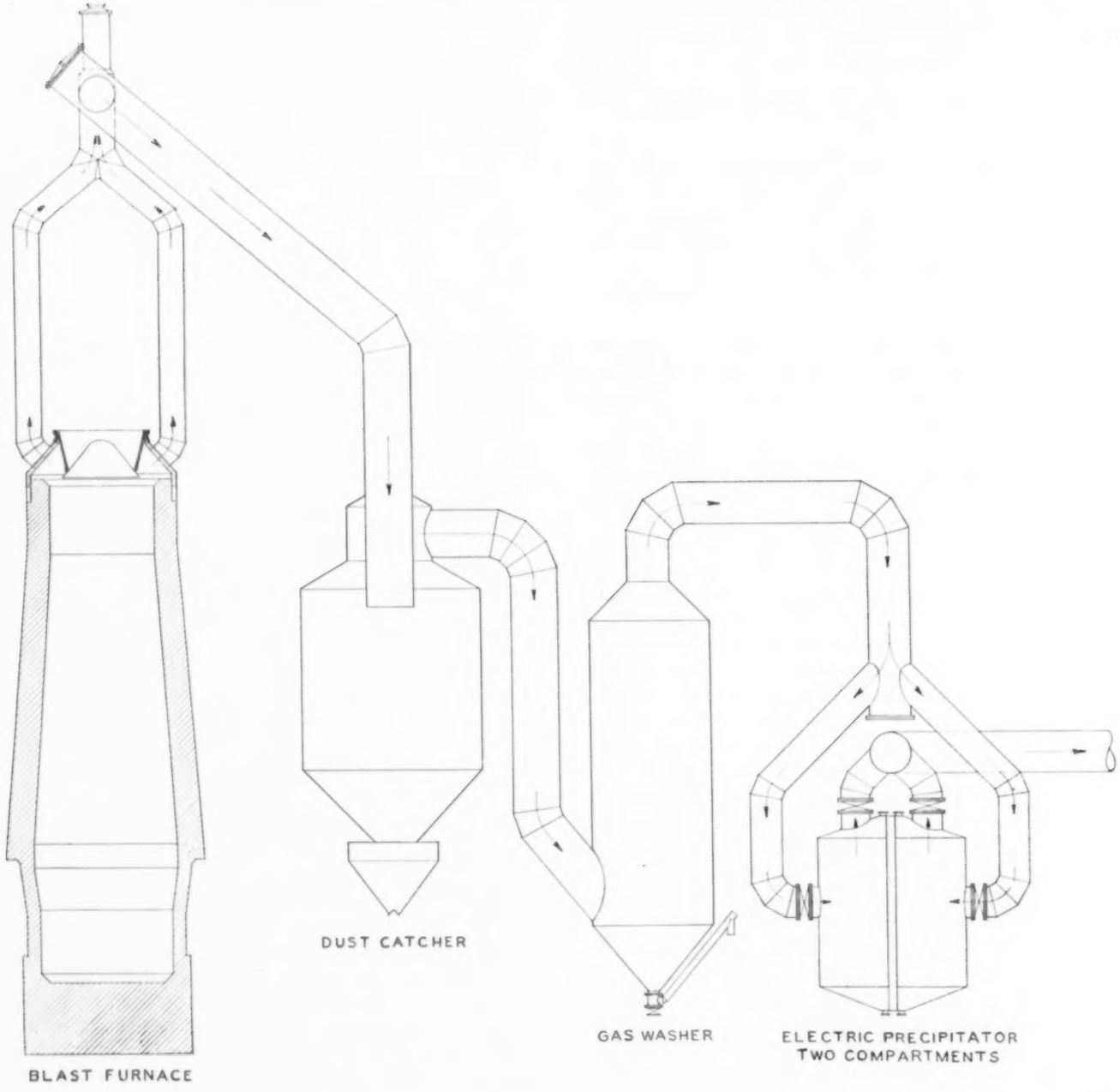
equipment is often installed for one set of conditions, but it is unusual if these conditions are not changed before the equipment is discarded or worn out. All gas cleaning units are percentage cleaners, that is, each removes only a percentage of the solids which enter it. Therefore, several units are usually required for each job, and the efficiency of each unit should be made as high as possible, so as to reduce the load on those following. As the gas becomes cleaner, it is increasingly difficult to remove the remaining solids. It has been proven by experience that when two duplicate cleaning units of the same size and with the same internal elements are placed in series, that the efficiency of the second unit is very low, as compared to the first. Or, if duplicate cleaning units are to be used, they should be used in parallel.

There still exists some variation of opinion as to the extent that blast furnace gas should be cleaned for different uses. However, most operators agree and feel that it is economical to fine clean all the gas.

There are two schools of thought about methods of cleaning gas, the one favors the all dry method and the other favors a semi-wet method. Up to the present time a combination of the two seems to be the best answer for most requirements. Whether a satisfactory all dry system can be developed to economically meet all requirements, only time will give the answer.

A simple and practical method for fine cleaning ordinary blast furnace gas today, which takes the smallest space and requires the least capital investment and operating cost, consists of a large dry dustcatcher, with a separate dust recepticle at the bottom, followed by a static tower washer with special ceramic spiral tile banks and removable stationary sprays. In the top of the washer should be an efficient moisture eliminator, with a large contact area, arranged so that the gas is required to turn one or more abrupt angles to its exit, and the moisture collected should be bled off out of the gas stream. The washer should then be followed by a two-compartment wet electrical precipitator. Such a combination of cleaning units of the proper size will produce dry clean gas to meet any ordinary requirements and is shown on Figure 4. Up to and including the time when fine cleaning of the blast furnace gas developed in this country, it was assumed that all ordinary grades of iron gas required the same amount of treatment to clean it. However, it did not take long to discover that as the silicon content of the iron was increased, the gas was increasingly more difficult to clean. Ferrosilicon and ferromanganese made in the blast furnace produce gases which are very difficult to clean. In some ferrosilicon plants, raw coal is used to make up part of the fuel charge, and these gases are extremely difficult to clean. The coal produces a tar vapor in the gas, and unless the gas temperature is held within close limits, the tar condenses, combines with the solids, and adheres to the mains and cleaning equipment. Two such plants are operating in this country, both of which use dry cleaners, followed by dry electric precipitators.

Figure 4 — Sketch shows arrangement of various units to give a complete gas cleaning system.



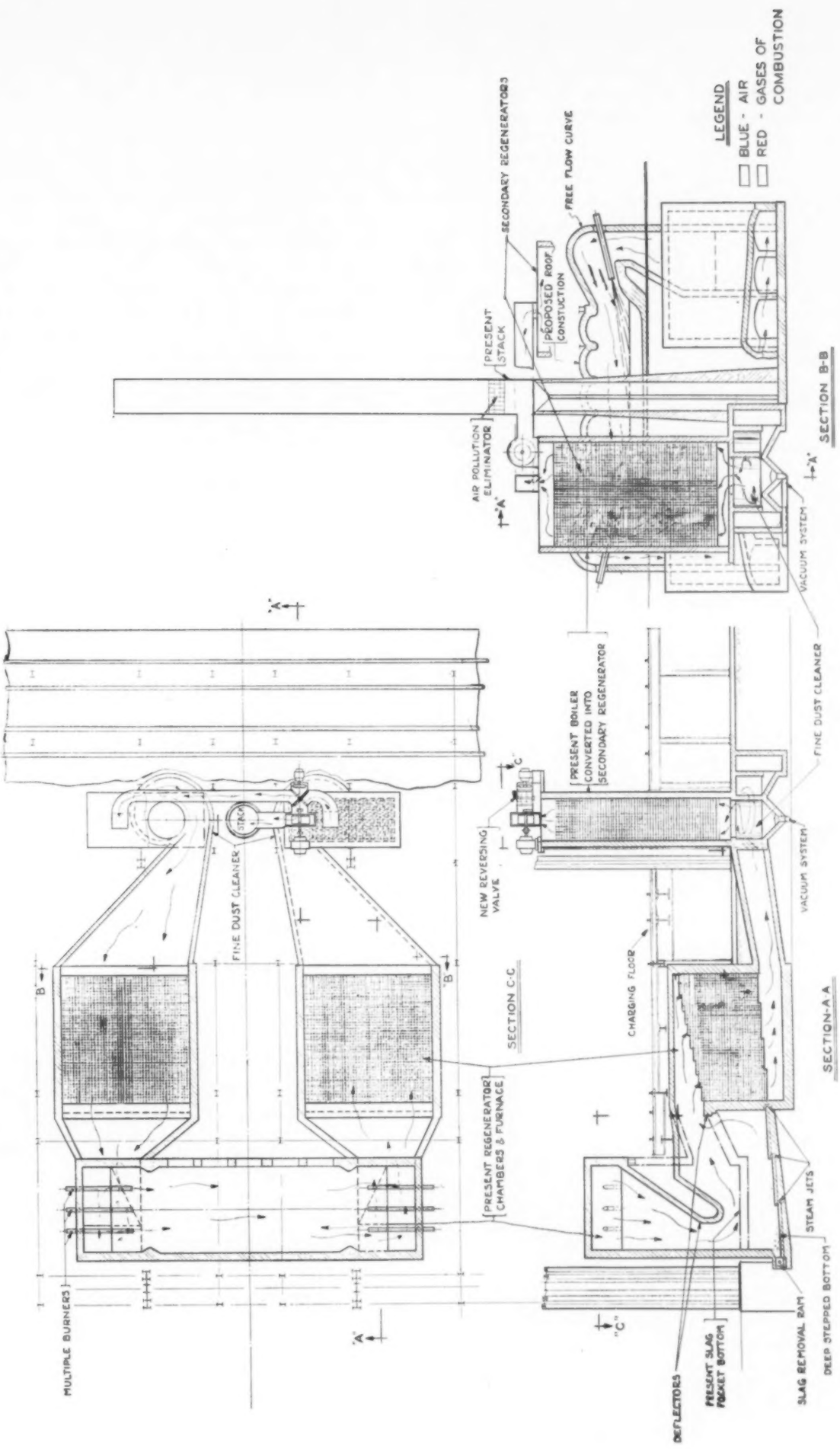


Figure 5 — Sketch shows proposed change to an open hearth furnace which will eliminate some of the dirt.

A pilot plant consisting of a dustcatcher, humidifying cooling tower and dry electrical precipitator has been installed and operated at another blast furnace producing ferromanganese. The dry gas passes into a humidifying and cooling tower where it is closely controlled for temperature, after which it passes into a dry electric precipitator. The results obtained are said to be satisfactory enough to warrant a large duplicate installation to clean all the gas from one blast furnace.

At another blast furnace plant ferromanganese gas is being cleaned by a dustcatcher followed by two static gas washers in series. The first washer is provided with sprays only, without any internal elements, while the second washer is provided with four banks of hurdles composed of steel pipe laid horizontally, with the alternate rows at right angles to each other. Above each hurdle bank is a set of sprays. This washer is followed by a rotating disintegrator and moisture eliminator. It was the practice to have a spare rotor, and when the one in operation needed cleaning, about every thirty days, the rotor was removed from the disintegrator and a clean one installed in its place. However, recent experiments have been carried on to clean the rotor in place, through hand holes in the casing. Ferromanganese gas from this equipment is cleaned to meet all requirements for steel plant use.

In open hearth furnace operation, a high percentage of solids are carried over from the bath with the burned gases, which are at high temperatures. At the ends of the bath, slag pockets of varying size and depth are provided to catch some of these solids, before they enter the checker chambers. The slag pockets of most existing open hearth furnaces are too shallow and small, so that as solids accumulate in them, the gas area is gradually restricted. This, in turn, increases the velocity of the gas and its capacity for carrying more solids. Under such conditions, the solids carried over and deposited in the checkers and flues are progressively increased from the start to the end of each campaign, thereby decreasing the furnace efficiency.

Experience with the use of oxygen in the open hearth furnace aggravates and increases the carry over of solids, so that with the use of oxygen, much greater and heavier deposits are made under the checkers and in the flues. These burned gases in the slag pockets are 3000 F, and in order to clean them, it is necessary to do so with refractories, as no other materials will stand this temperature. The most effective way to clean these gases, according to experiments, is by a system of refractory deflectors and deep pockets with stepped sloping floors. A generally accepted theory, for cleaning any gas, is to slow down the velocity and cause it to turn through angles of 180 degrees or more; as by so doing, a high percentage of the solids are thrown out of the gas stream by centrifugal force and gravity. A refractory suspended arch projecting into the end of each slag pocket causes the gases to turn 180 degrees near the end walls and travel the entire length of the pockets, where they contact another deflector ahead of the checkers. This design is shown on Figure 5.

Such an arrangement causes the gas to flow in a long and torturous path and deposit 95 per cent of the solids at the end walls and in front of the steps. These solids deposited on the deep stepped sloping slag pocket floor can be removed at each furnace reversal by steam blowing through floor nozzles at each step. This granulates the slag and forces it into a horizontal ram working back and forth, which deposits the slag outside of the furnace. After the heavy solids are collected and removed, and the temperature reduced, the lighter, or floating solids, can be successfully removed by a dry plate electric precipitator, or other means, with an induced fan pulling the gases through it. Such an installation is in operation now and meets all the local requirements for air pollution. It must be kept in mind that for the successful operation of the precipitator, the gases entering it must be reduced to about 450 F. This can be accomplished by passing the exit gases from the open hearth through waste heat boilers, or preferably, through secondary checkers at the base of the stack, as shown. Cleaning gas presents two pollution requirements which have to be met. One, the discharge of waste water clean enough so as not to contaminate the streams; and the other, the discharge of waste gases clean enough so as not to pollute the atmosphere. The contamination of streams has been gradually solved by the use of thickeners over a period of years. Most thickeners meet the general standard requirements all over the country of discharging waste water with not exceeding 10 gr of solids per U. S. gallon of water, and the addition of coagulants, 5 gr per U. S. gallon is possible.

Air pollution is the release of dust and fumes into the atmosphere from any source, including those from all industrial plants. A standard method which has been used and approved by the Bureau of Mines for making quick and fairly accurate determinations of air pollution is by the use of the Ringelmann Chart. This is reproduced in Figure 6.

This chart is divided into five grades of density in 20 per cent graduations and numbered from one to five. The chart is placed at a sufficient distance from the eye to cause the lines to merge similar to the appearance of smoke. Then, it is compared with the smoke under observation. The lines of the chart will merge at from 15 to 20 ft from the eye. A No. 1 smoke is 20 per cent dense, or shuts off 20 per cent of the light passing through it, and other densities are indicated according

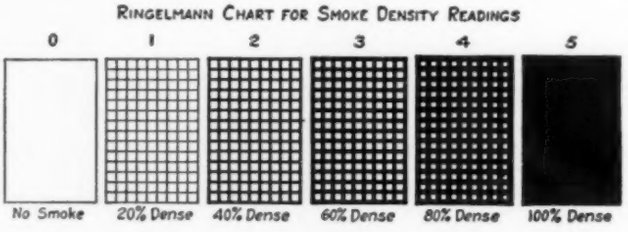


Figure 6 — Ringelmann chart for smoked density readings.

to the numbers which correspond to them. To date, no specific standards for the control of air pollution have been made which are applicable to the entire country. However, many areas have made regulations to meet their own local requirements. A regulation from one of the western areas under which open hearth and blast furnace gases exhausted to the atmosphere are con-

trolled, is on the basis of process weight per hour. For example, if the total charge to an open hearth furnace is 30 tons, and it takes 10 hours to produce the heat, the process weight per hour would be 3 tons. From the table, it is found that a maximum weight of 7.37 pounds discharge to the atmosphere per hour is permissible for this operation. It is interesting to note that a recent installation, of a dry precipitator on an open hearth furnace stack in this area, is cleaning the exit gases to meet these regulations.

Summarizing, to clean industrial gases, each cleaning unit should be of simple design and operated at high efficiency. The dust and moisture, once removed from the gases, should be bled off out of the gas stream from each unit, as it is collected. This will prevent the gas from picking the solids up again, and placing a heavier load on the cleaning units following. Stopping the pollution of streams and the atmosphere, which appears like a big burden now, will be solved and eventually be a benefit to those plants which have such problems.

DISCUSSION

PRESENTED BY

D. C. AFFLECK, Assistant to Chief Engineer, Gary Steel Works, United States Steel Co., Gary, Ind.

A. J. FISHER, General Manager, Bethlehem Steel Co., Johnstown, Pa.

JAY J. SEAVER, Jay J. Seaver Engineers, Chicago, Ill.

D. L. NEWKIRK, Manager, Blast Furnaces and Coke Ovens, Ford Motor Co., River Rouge Plant, Dearborn, Mich.

David Affleck: In cleaning blast furnace gas for coke oven battery firing at Gary Works, we have gone beyond, I believe, anything here mentioned, namely, 0.002 gr per cu ft. This was accomplished by using electric precipitators hooked up in series. We are now using blast furnace gas so cleaned on seven coke oven batteries. The primary cleaning unit ahead of precipitators was a very simple form of gas washing tower. It consisted namely of six banks of rashig tile, each one foot deep, spaced within an 18 ft diameter steel shell. All banks were subject to water spray except the top one, which acted as a water eliminator.

A. J. Fisher: In cleaning blast furnace gas, we have in mind the throat of the blast furnace itself as being the first place to eliminate dust or to save dust. In terms of areas, we think that the throat area ought to be about the same as the area of the hearth. This gives a slow throat velocity-making less dust. I think Mr. Seaver has given us some good ideas about dustcatchers and I am quite in accordance with his cone at the bottom, and I think he ought to tell us a little bit more about that cone, especially about maintaining the dust level or knowing when to dump the cone so that the dirt does not get up into the dustcatcher. It seems Mr. Seaver has a very good idea on dustcatchers.

Relative to open hearths, Mr. Seaver talked about cleaning flue gases, I am not too familiar with what he has outlined, but I know it is a very difficult job. I do not understand how he is going to take out fine dust particles with the mechanism he has shown. A slag pocket is a place where liquid materials accumulate and it is awfully hard to remove these solids from the gas stream and then granulate them on the slag pocket floor for removal. I highly agree with the two secondary type checker chamber arrangement using a high velocity through each chamber.

Jay J. Seaver: I can probably show you better by this model how we propose to remove the solids from the gas. Gas comes off the end of the open hearth furnace and in each end is a suspended refractory deflector which causes the gas to turn 180 degrees and throw the solids into the ends of deep stepped slag pockets.

At each step on the bottom is a steam manifold to which are connected steam nozzles. On each furnace reversal, steam is turned on which granulates the slag and also blows it into the pocket ends, where it is removed by a ram. Ninety-five per cent of all slag pockets are too shallow.

Everybody will agree that you must clean the gases in order to have an efficient checker or regenerator system. In order to conserve heat or fuel, you must have small checker openings, high heating surface and high velocities with high heat exchange.

D. L. Newkirk: As for that extra cone and the gas picking up dust, I have, on more than one occasion, had to dynamite the dust out of a dustcatcher and that was while we were operating, too. Sometimes, you know, you do not get cars to dump this dustcatcher when you want to dump it. Scheduling around a blast furnace is not under control like it is on a production line.

Regarding the cleanliness of gas, I see no argument any more at this time and age for gas not being cleaned to double ought for use under coke ovens, high pressure, high-steaming rate boilers and small checker stoves, and it seems to me that emphasis is often on the average performance of a piece of apparatus. It is not the average performance that really bothers one, it is the short period of time when things are not in the groove that really ruins your apparatus. If you want double ought gas every minute of the day, you are not going to get it without disintegrators.

Nothing has been said so far about the effect of oil in gas. The oil comes from scrap. I do not know any cleaner that will take it out, but I do know that even with double ought gas producing what we call fume, which we always said would go through our equipment and out the stacks when dry, we are continually plagued with mud at the coke ovens, blast furnace gas valves in the alleys and with build-up on the nozzles of the burner in the boilers.

AVOIDING TROUBLE IN

▲ A common condition found in most steel plants is the soaking pit department being behind the "eight ball," because of retarded production as a result of "nothing hot" delays, and because of quality deterioration due to lack of more complete heating and soaking. The combination of conditions peculiar to soaking pit operations, to a degree still present regardless of the so-called modern pits, are such that it places the operators in a difficult position to meet the demands of production on the one hand, and satisfy the demand for quality and efficiency on the other.

In many cases, the best that can be done is to dodge the troubles as much as possible and make the best of the conditions at hand. While this practice prevails, soaking pit operations are still open to criticism, in that greater efficiency could be obtained along with improved quality by reducing the effect of any one or a combination of conditions responsible for a "nothing hot" delay, or inefficient soaking pit operations.

What do we mean by a "nothing hot" delay? The common expression "nothing hot," as used over the years, tells us very little as to the true cause of delay, other than the pits were unable to keep the mill in operation and from time to time this department is reminded of how much production was lost as the result.

A delay of this type is only the effect of a contributing cause, which in some cases is beyond the power of the soaking pit department to control. Formerly, for example, the proper firing of a gas producer was so important in heating the pits in the minimum time that it accounted for the difference between a pit being hot on schedule or long past. Today the pits are supplied with fuel of a measured Btu value—the recommended volume and air-gas ratio being controlled to produce the fastest heating rate permissible for a given grade of steel with our present equipment.

Our metallurgical departments have determined the time required for ingots to remain in the pits for good heating practice. When we find the time of heating a pit does not exceed the minimum recommended time set up, and a delay develops, the true cause is then something other than "nothing hot."

Turning the spotlight on the "why" of such delays, will reveal the leaks, many of which could be plugged up, and pay off in greater production, lower cost and better quality.

It has been wisely said we can only predict the future by the experience of the past, along with our knowledge of today. It may be well to go back a short time in the past to the early thirties to get a better view. When the first serious look for a long time was given to soaking pits, one writer, after making a study of pit conditions, stated that the forgotten department of a steel plant was finally revealed as the soaking pits. It was found to be struggling along to keep up with the ever increasing speed and production, as well as more efficiency, and crying out "wait for me." All too often they had to wait.

. . . . a good pit operator requires heating know-how, metallurgical and combustion knowledge, and experience with instrumentation . . . .

The attitude over the years in respect to the soaking pit department as a link in the chain of operations, was that of a necessary evil—a subject to be pulled along like a caboose on a freight train. As a result of this the pits had to get along as best they could with equipment in poor shape and long over-due for replacement.

The result of these findings showed a forward movement in new designs of soaking pits—each of which showed a definite improvement over the old. It could safely be said, the difference between these and the old was as great as the old compared to the modern car. Many plants have therefore availed themselves of these modern pits suitable for their local needs.

However, as sometimes happens, we fail to see the woods for the trees. The spotlight was so strongly focused on the new pit proper, that other contributing factors which tend to make or break efficient soaking pit operations were overlooked. Many of these remained and had to be dodged continually.

As there appears to be a movement throughout the steel industry to take another look at the soaking pits for further expansion and development, it may be timely to focus the spotlight on other contributing factors.

First, we would like to comment on the pit proper. I think it is safe to say that sometimes the possibilities of the automatization have been overestimated. It is still impossible to dip the ingot into the pit, push a button and draw it uniformly heated to a proper temperature. The modern pits, while accomplishing much, have not eliminated the time and temperature factor. The heat diffusion within the ingot, different for different grades of steel, necessitates a minimum time of soak in order to satisfy the requirements of quality. Whereas there is room for improvement, while determining this minimum time, it is still strongly correlated with track time and usually is a figure not too much different from its value. The pit where all four sides of an ingot are uniformly exposed to the heating source during the heating cycle, has not as yet been developed.

A false impression, inferred if not directly stated, at the time when modern pits were being discussed, was that the skill in a heater was no longer required as these pits were automatic, only requiring the pushing of a button, the controls doing the rest. We would like to suggest to accomplish greater efficiency, heaters or operators require a greater knowledge and skill than

SOAKING PIT OPERATION

By D. J. McGEARY
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ever. The good operator needs to know the "know-how" of heating as well as sufficient technical knowledge of metallurgy and combustion, along with a reasonable knowledge of the various controls. Efficient heating today demands a more qualified operator than in the past.

To appreciate some of the difficulties of soaking pit operations, it is necessary to start with the location of the pits. Being placed as they are (and should be) between the open hearth and the blooming mill, they act as a shock absorber for both ends. Should difficulties arise at the open hearth or the mill, the pits must bear the brunt, and at times this results in a "nothing hot" delay for the pits, as well as upsetting the plans. This could be classed as eight ball No. 1. We feel much could be done at both ends to relieve this effect.

Another one of the eight balls always with us, is sticker ingots. While some improvement has been made to reduce sticker ingots, reference to them is still common talk. We all seem to have our share and suffer the results of "nothing hot" delays as a consequence. On the one hand we have a blooming mill operating at a constant rate which must be supplied with hot ingots. The pit charging rate is not constant. The spread between drawing rate and charging rate becomes greater as charging delays develop from stickers, etc.

The bunched tapping of heats at the open hearth is another common condition causing lost time. When numerous heats are tapped and sent to the pits in a short time, followed by a period when no heats are coming, assuming that empty pits are available, the time required for charging the first heat is added to the track time of the second and doubled on the third, etc., the last heats charged having a long track time and are hence colder. After this, cold steel if available, is charged to fill in the gap. The time arrives when only the heats with long track time and the cold steel is in the pits—neither of which is in long enough to be hot—which results in the mill getting a delay, along with adding to the cost of fuel consumption, etc.

These illustrations should be sufficient to show that the installation of modern pits alone is not enough—we must put the spotlight on the items that hold up efficient pit operations, and do something about it.

We would like to give a few illustrations of how some of the causes of delays were removed at the Steel Co. of Canada, Limited. As a result of increasing open hearth production and of insufficient transportation equipment, our track time of heats being charged at the pits, amounted to 4½ hr. An additional engine was added to the service, along with a few other improvements that resulted in our average track time being reduced to 2½ hr. Needless to say, the effect this had on the pits was increased production and lower cost and improved quality.

As a result of new coke ovens coming into use, making available additional coke oven gas, we changed from a mixture of 10 parts blast furnace to 1 part coke oven gas, with approximately 133 Btu per cu ft, to a mixture of 6 parts blast furnace to 1 part of coke oven gas with approximately 155 Btu per cu ft. Whereas the 10 to 1 mixture required, to meet metallurgical requirements of uniformity of temperature within the ingot, a minimum pit time of track time plus 1 hour (for track times up to 6 hours) the 6 to 1 mixture requires a minimum pit time of track time plus 15 minutes.

We discontinued the conventional bottom making method of using coke breeze on our pits and converted these over to a dry cinder bottom, as follows. We start off on a new pit by filling the cinder holes to floor level and use about 1 in. of chrome dust to cover brick bottom—then, allow the scale and drippings, etc., from the ingots to accumulate and build up approximately 14 in. to 16 in. This takes from 4 to 8 months, depending on type of ingots charged. The pit is then shut down for cleaning for 24 hours. This cleaning is as follows: the pit is cooled for 16 hours during this time; a small stream of water is sprayed on the cinder bottom (care must be taken that no liquid slag is present when water is first applied, to prevent a possible explosion). The water tends to both cool as well as soften the slag. Then the water is shut off and two bottom makers go in pit, using large air guns to dig out the bottom. This operation takes about 8 hours or 16 man-hours labor, allowing about one inch slag to remain covering the brick bottom. No further chrome dust is required. The total down time is 24 hours, 16 hours cooling, 8 hours cleaning.

This change in the making of the bottom permits our pits to remain in continuous operation for at least 4 to 8 months as against 7 days in the past. For all our soaking pits, the economical effect per annum was as follows:

Saving of coke breeze	— 4,300 tons
Saving of labor	—23,000 man-hrs
Increased heating capacity	—44,000 tons of steel
Increased yield of 1 per cent	—12,000 additional tons of steel per annum.

EQUIPMENT MAINTENANCE

Aside from such conditions that may be considered local and possibly unavoidable, there is to be found a wide difference in the life of soaking pits and equipment. For example, construction and material being

equal, it will be found that the life of a pit cover varies anywhere from a matter of months to 7 or 8 years. The same will be found with pit walls and other equipment. None of us have all the answers for these things, but we do know they exist, with a large field to be explored.

To deal with this problem among other things, we have put into effect a breakdown report that is made out by the heater in charge of shift, signed by the operator of equipment in question, reporting the story of what happened that caused damage. The purpose of it is to follow up the cause and overcome the weak links when found to be at fault, and to cause the operator to become more conscious of the equipment he operates. We found this practice to be very helpful in reducing damage to equipment.

Another point may be of interest which occurred during the past war when oil was first used on our pits for fuel. In this case, the center of our bottom fired pit covers were being damaged as a result of the oil flame being strongly directed on this section, caused by the type of burner being used. A suitable burner not being available, we designed one of our own which produced a cone shaped flame. In this way we overcame the damage as well as produced a more uniform heating.

Sufficient pit capacity is always a very important factor necessary to dodge the eight ball. At the Steel Co. of Canada, additional pits have been added from time to time. At the present time, an additional two holes of top fired pits are under construction. Along with an old 4-hole row of small regenerative pits, being converted over to a 2-hole row, it is estimated they will produce 30 per cent more. Nonetheless, we would like to leave the thought that additional pits alone are not sufficient.

The troubles that soaking pits appear to be burdened with and must be dodged demands that a conscientious effort be made to search out the "why" and steps taken to eliminate the causes whenever possible. We would suggest that an itemized list of these be made in your own local case, then evaluate and determine as to the possibility of improvement.

As a starter we propose that a number of questionnaires be made up to be answered by those concerned, for example:

Heaters

Q—What are the difficulties that prevent you from producing greater production at lower cost and better quality?

A—

Q—What can we do to help you?

A—

Combustion Department

Q—What are the difficulties that prevent greater efficiency at the soaking pits?

A—

Q—What would you suggest for improvement?

A—

Metallurgical Department

Q—What are the difficulties that prevent improved quality at the soaking pits?

A—

Q—What do you recommend to effect improvement?

A—

Engineering Department

Q—What would you suggest to speed up the handling of ingots at the soaking pits, with the equipment at hand or such means that would not involve large expenditures?

A—

We offer the above only as illustrations. You can make up your own questions and send to whomever you think will be of help. If the returns are conscientiously followed through, the effort will have been worth while, and result in greater production, lower costs, and improved quality.

DISCUSSION

PRESENTED BY

A. M. CAMERON, Supt. Rolling Mills, Atlas Steels, Ltd., Welland, Ontario, Canada.

D. J. McGEARY, Heating Foreman, Soaking Pit Department, Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada.

GEORGE R. SACKERSON, Assistant Supt. Bar & Structural Mills, Bethlehem Steel Co., Lackawanna, N. Y.

JACK MILLER, Instrument Engineer, Republic Steel Corp., Buffalo, N. Y.

JAMES O. DAGUE, Assistant Supt. Mechanical Dept., Bethlehem Steel Co., Lackawanna, N. Y.

CHARLES C. HILTON, Maintenance Foreman, Bethlehem Steel Co., Lackawanna, N. Y.

HENRY C. MULLINS, Senior Engineer, Combustion Department, Bethlehem Steel Co., Lackawanna, N. Y.

A. M. Cameron: What means of control do you have in order to maintain fuel at 155 Btu using mixed blast furnace and coke oven gases?

D. J. McGeary: I might say we do not have the best of control at the present time for maintaining 155 Btu. We call it that. What we do is feed coke gas into a branch blast furnace line. By means of differentials of flow of blast furnace gas and feed coke gas to that, at a ratio of one part coke oven gas to six parts blast furnace gas which gives us approximately 155 Btu per cu ft. However, if any change takes place in the Btu valve of the gases delivered to us our mixed gas will have a false value.

George R. Sackerson: I wonder if you have found the track time has a definite bearing on quality?

D. J. McGeary: Yes, by all means, track time is very important. Let me put it in the way that we heaters term it. We say that when you get steel into the pit with a low track time, you have your greatest amount of heat contained in the ingot itself, and you are heating, as it were, from the inside out. You will produce a much better quality than you will if you are heating from the outside in, which you would be doing when you are heating colder steel.

George R. Sackerson: You mentioned a reduction of approximately 4½ to 2½ hours in track time. Is that 2½ hr from the start of tap, or end of the tap, in the open hearth?

D. J. McGeary: That is the start of pour to finish charge, but in large ingots, where there is a possibility of a very short track time and a possibility of having a liquid condition in the inside of the ingot, called "green steel," we take the time of the finished pour, because there is a possibility of the tail end ingots on the heat being a lot hotter than the first pour. We use both, but under normal conditions, we take the start of pour, and for large short track time ingots we use the finished pour.

George R. Sackerson: You mentioned the addition of an additional engine to produce this reduced track time. What is your narrow gauge organization that permits you to get that track time? Do you have a direct communication system responsible for that? How do you contact your engines to give heat preference? Of course, you only have one blooming mill but even at that, you must have some preference in the heats you want to get hotter steel delivered first.

D. J. McGeary: In our case the engine that delivers the ingots comes under the control of open hearth. As I have mentioned, they originally had only one engine to service their own end, as well as get steel to the mill, but the production increased to such an extent that it was not possible to do a good job of getting the heats to the pits with a low track time and so there was the addition of another engine. It was not the engine alone. Other things came in there. Such as the use of another pit crane, etc. The point I wanted to convey was, there was a problem there. That problem was overcome by a combination of various things, and the engine was just one of them. By the same token I feel similar problems can be overcome with similar action.

George R. Sackerson: I am speaking mainly of holding time in the open hearth, which is one thing you have to correct along with good transportation, to get hot steel. Now, do you have any special holding times on ingots, other than what it takes to solidify the steel, to give you a good quality ingot coming in the pits?

D. J. McGeary: I think I am safe in answering that. Normally that should be a metallurgical answer, but if I understand your question clearly, you are dealing with open tops, semi-killed, and rimmed steel, as to whether there is a holding time in addition to the solidifying time. I would say, in those particular grades, no. They endeavor to ship them over just as soon as possible. There have been holding times in the past, but that has been cut down to practically zero for those particular grades now, and I think the metallurgists will agree we have not experienced bad effects as a result.

Jack Miller: What do you use as a primary element to actuate your controls—a radiation head or a thermocouple?

D. J. McGeary: Thermocouples.

Jack Miller: Are those platinum-type thermocouples?

D. J. McGeary: Yes, platinum-rhodium.

George R. Sackerson: You do not mention the chrome dust type of bottom for regenerative pits; I take it you do not use it on these furnaces. Have you not found chrome dust satisfactory?

D. J. McGeary: I would not advise the use of dry bottoms on regenerative type pits. Some years ago, I recall down at the Saucon plant we ran into a labor shortage and we were trying various things to get by, and so we left some of the regenerative pits go without making bottom for a while and we discovered the slag ran into the checkers and blocked them up. We still make the bottom in our two rows of regenerative type pits the conventional way. The explanation of this may be done more satisfactorily scientifically, but my own way to explain that would be probably this: that in your regenerative-type pit you have your flame going across the bottom of your pit and normally the heating takes place from the butt upwards, so that the bottom part of the pit, so far as the coking feature is concerned, is the hottest part. Now, in the bottom fired, the flame is coming up in the center and heating takes place from the top down. The same thing is true in top-fired furnaces which are over-fired. Your heat there again takes place from the top down and it seems the effect in the bottom part of the pit itself is not the same in the bottom fired or over-fired as in the regenerative type. There have been some that have tried it on the regenerative type but I would not recommend it.

James O. Dague: You spoke of getting one per cent increased yield when changing from the conventional bottom. Do you contribute that to a change to the dry bottom or to a different method of heating?

D. J. McGeary: It is a combination of both. We found that the conventional bottom having a certain amount of slag deposit in the coolest molten state, had a tendency of clinging to the bottom and sides of the ingot. That has been a common condition, as many of you know. To overcome that, often ingots were charged upside down to get the deposit on the top of the ingot where it would be cut off afterwards. When we converted them to the dry bottom we found the butt of the ingot was just as clean as the top, there was no liquid slag on pit bottoms. In running a test, we charged a pit of a heat in one of the pits with a dry bottom and a pit of the conventional type, and made a comparison. We had three different groups checking that at the time and we obtained figures from one-half of 1 per cent to 3 per cent difference, and we compromised and called it 1 per cent.

James O. Dague: Was that in the same pit? You said the dry bottom versus the conventional bottom. But was the conventional bottom a regenerative-type pit and the dry bottom one of your other pits?

D. J. McGeary: The comparison was made between the same type.

Charles C. Hilton: As you know, we have regenerative pits and top fired pits. You have two top fired pits, and I wonder if you have had them in operation long enough to form any conclusions about the time required to soak out your ingots in comparison with your bottom fired pits. Have you been able to get away with a dry bottom on the two new ones?

D. J. McGeary: I might say, in-so-far as the bottom is concerned, we have no choice. The bottom does not have cinder holes and we cannot make a coke bottom in there. We have to have a dry bottom, which we are

doing. On the comparison of heating between our top fired pit and our bottom fired type pit, we are not prepared at the moment to say whether the difference is better or worse because the two holes of top fired have not been in operation long enough.

Charles C. Hilton: I am not familiar with the location of thermocouples in your new top-fired pits. Have you any plan as to how many and where you are going to place them in these two pits?

D. J. McGeary: When this pit was first proposed, there was just the one couple at the upper part of the pit in the wall, and while one couple may be quite satisfactory in many cases, depending on your local conditions, in our case we are handling various grades and sizes of ingots and so forth. I do not feel one couple at the top of the pit is satisfactory. So far as a top couple is concerned, it is tremendously influenced by flame temperature. The relative difference between the upper part of pit and the lower part of pit is sometimes considerable, and so to look at a chart which is only showing the temperature at the top of the pit is no definite indication of what you have below. I do not feel it is satisfactory, and so as a result, in addition to the couple located about three feet down from top end wall that we propose to use as a top limit, we installed two others, one in each of the waste gas outlet ports that will be used to control steel temperature, making three couples in each pit.

Charles C. Hilton: When you refer to a couple at the top, do you refer to the cover or several feet down in the wall from the burners?

D. J. McGeary: In dealing with the new top-fired pits, the couple is several feet down from top of end wall. It is the conventional place for a top-fired pit. The couple in our bottom fired type is located in the cover.

Henry C. Mullins: I would like to know the location of the bottom couples in the recuperative pits?

D. J. McGeary: In our new one way, top-fired pits, bottom couples are located one in each of the two waste gas outlet ports. In the bottom fired type pits, a couple is located in each of the four corner outlet ports. In both cases the couple is approximately 20 in. away from the butt of ingot.

George R. Sackerson: In connection with soaking pits and other furnaces, to what extent do you consider pit pressure as a contributing factor in good heating practice?

D. J. McGeary: A regulated positive pressure is essential in all type heating furnaces for good heating practice. The amount of positive pressure can best be determined by experiment. In our case we use 0.03+ positive on the top fired pits, and 0.02− on the bottom-fired type, the difference being due to the location of pressure sampling tube. In the top fired pits, sample is taken near top. On the bottom fired type, sample is taken near bottom of pit, the pressure near top of pits in both cases being the same 0.03+.

AID DEFENSE

MORE SCRAP TODAY . . . .

MORE STEEL TOMORROW.

GET IN THE SCRAP TO KEEP STEEL COMING.

NON-FERROUS SCRAP IS NEEDED TOO!

By D. E. STAFFORD
Chief Engineer
National Electric Coil Co.
Columbus, Ohio

DEVELOPMENTS IN COILS AND INSULATING MATERIALS

. . . . new insulations will greatly extend the ruggedness and dependability of electric motors . . . .

▲ THE period in which we are living has been called the "atomic age." This descriptive phrase can also be applied to electrical insulation and many of its recent developments. In fact, some of our new insulation materials are a direct result of the atomic energy development program. Rotating electrical machinery developments include, of course, not only better insulation, but also improved magnetic core materials, better lubrication, as well as better winding electrical design. We shall first consider some of the newer insulating materials and their application to electrical windings. We will then consider briefly some developments in motor and generator windings and winding methods.

We become aware of the losses of electric motors and generators when we place our hand on the frame and feel the warmth. In many cases, due to the need for more production from a given piece of equipment, the output required from the electrical driving motor has increased over its original installed capacity. This increase in output naturally means higher heat or I^2R losses. This is also the watts to be dissipated as heat loss. Heat produces accelerated aging of the insulation which leads us to apply the term—LIFE—when expressing one of the important qualities of insulation. The ability to withstand operation at limiting high temperatures is the basis for standards of insulation classification as set up by AIEE. These AIEE classifications are shown in Table I. Hottest spot temperatures that have been established from experience are shown in Table II.

Electrical machinery nameplates show a certain temperature rise in degrees centigrade. This means the machine will reach a temperature equal to this rated temperature rise plus the ambient or room temperature when it is loaded to its nameplace capacity. If we have a 30-degree C ambient temperature, the limiting temperature rise or "hottest spot" *temperature rise* of Class 'B' insulation is 100-degree C. (130 C—30 C ambient= 100 C temperature rise).

The temperature limit is not the only criterion for electrical insulation. Other design requirements, such as electrical and/or mechanical stress, exposure to corrosive chemicals, and excessive moisture frequently

TABLE I

AIEE Classification of Insulating Materials

Class	Description of material
O	Class O insulation consists of cotton, silk, paper, and similar organic materials when neither impregnated nor immersed in a liquid dielectric.
A	Class A insulation consists of: (1) cotton, silk, paper, and similar organic materials when either impregnated or immersed in a liquid dielectric; (2) molded and laminated materials with cellulose filler, pehnolic resins and other resins of similar properties; (3) films and sheets of cellulose acetate and other cellulose derivatives of similar properties; and (4) varnishes (enamels) as applied to conductors.
B	Class B insulation consists of mica, asbestos, fiberglass and similar inorganic materials in built-up form with organic binding substances. A small portion of class A materials may be used for structural purposes only.
H	Class H insulation consists of (1) mica, asbestos, fiberglass and similar inorganic materials in built-up form with binding substances composed of silicone compounds, or materials with equivalent properties; (2) silicone compounds in rubbery or resinous forms, or materials with equivalent properties; a minute proportion of class A materials may be had only where essential for structural purposes during manufacture.
C	Class C insulation consists entirely of mica, porcelain, glass, quartz and similar inorganic materials.

TABLE II

The Values of Hottest-Spot Temperatures Established for this Purpose are as Follows:

For Class O material	90 degrees C
For Class A material	105 degrees C
For Class B material	130 degrees C
For Class H material	180 degrees C
For Class C material	No limit selected

enter into the selection of the proper insulation grade. Steel mill applications frequently involve all of these operating conditions.

The term "silicone" is no longer something new to the majority of engineers since in one way or another they must have encountered it in the past five years. Silicone insulations are being used to an ever increasing extent in steel mill applications. The original silicone varnishes had excellent heat resistance (but they did not have mechanical toughness as compared to some of the newer modified synthetic resin varnishes). Solvent or oil resistance of these earlier silicone resins was not of the same degree as that of the synthetic resin varnishes. These two properties were no serious detriment to the application of the silicones. However, due to their not being equal to the other materials available, constant research development work pointed towards improvement has been and is still under way. Recently silicone varnish resins have been made available for treating glass wire coverings which have abrasion resistance and toughness comparable to the synthetic organic resin varnishes. Similar silicone resins are also under test on coil windings for motors and generators. Along with this improvement in toughness has come better solvent resistance.

Another silicone material which is being used for insulation of electrical windings is silastic. This insulation is a resilient rubber-like material with the ability to withstand continuous high temperatures that would seriously impair the resiliency of natural or synthetic rubber. Silastic will retain its insulating properties and remain resilient and flexible over a temperature range of 70 C to as high as 250 C. Recently, silastic has been made available in tape form under the designation—Type R. Type R silastic is a fiberglass cloth reinforced, pressure sensitive, silicone rubber tape in a semi-vulcanized state. After application of the semi-vulcanized tape to a coil, a short oven bake completes the vulcanization to form a homogenous, resilient insulating jacket that can be operated continuously at 180 C temperature. Figures 1, 2, and 3 illustrates some of the properties of silastic type R.

Silastic type R shows excellent resistance to erosion by corona as shown by testing high grade organic rubber and silastic under corona produced by 14,000 volts. Organic rubber fails in 10-minutes to ½ hr while silastic has successfully withstood this test for more than 2000 hours with no evidence of deterioration.

Silastic type R tape also shows good resistance to water as indicated by tests conducted on coils insulated with silastic tape and immersed in water for 75 days. These test coils maintained an insulation resistance value of 50 to 100 megohms.

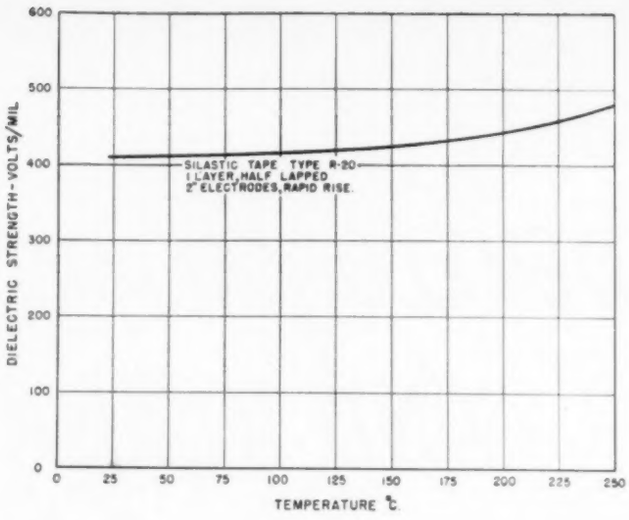


Figure 1 — Chart gives dielectric strength versus temperature for silastic tape type R-20.

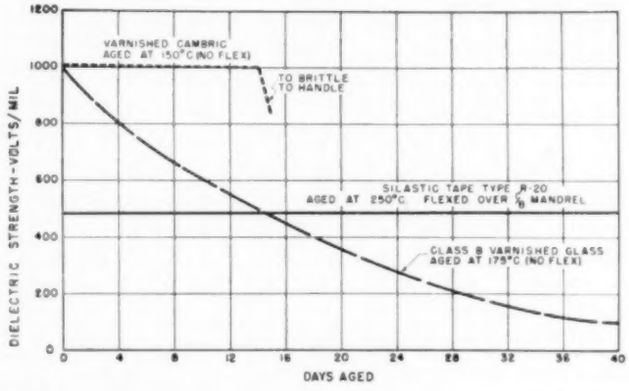
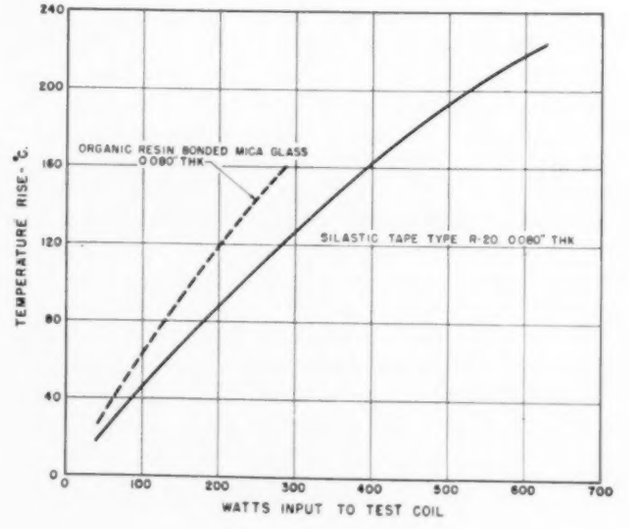


Figure 2 — Chart shows the effect of aging on dielectric strength for silastic tape and Class A and Class B insulating compounds.

Figure 3 — Chart shows thermal conductivity of silastic tape and mica-glass tape.



It is generally recognized that mechanical movement of electrical conductors, due to vibration and thermal expansion, will often cause rapid failure of the insulation. Even where coils are rigidly supported through the use of flanges and shells or fastened with secure banding, slot wedges, or other clamps, relative movement due to severe vibration and thermal expansion, will often cause rapid failure of the insulation. Heavy duty d-c motors, as used in steel mills and high speed railway traction service, are subjected to mechanical shock and widely varying loading that produce thermal expansion and severe vibration. Silastic insulation has been applied to the armature and field coils of these motors that see rugged service.

Another line of new materials are the fluorocarbons. These materials resulted indirectly from the atomic energy program. The fluorocarbons are combinations of carbon and glass fluorine. Fluorine is the most violent element on earth and is a relative of chlorine. These fluorocarbon materials assume many disguises. One of the principal manufacturers of fluorocarbon materials markets his products under a trade name, teflon, derived from the chemical name, polytetrafluorethylene.

This material is available in more forms than any of the other fluorocarbon materials. It is available in liquid form for wire enamels, etc. It is available in tubular, rod, sheet, and tape forms. Some of its properties are shown in Table III. The properties of prime consideration in the application to electric windings are its ability to withstand heat, its water resistance, its dielectric strength, its arc resistance, its chemical resistance, and its power factor.

Teflon is a Class 'H' insulating material since it will withstand continuous operation at temperatures well above 180 C. It is stable up to temperatures of 327 C (620 F). Molded bars kept at 250 C (482 F) for one month show only a 1 per cent loss in tensile strength. Teflon also maintains its strength, flexibility, and electrical properties at temperatures as low as 70 C (94 F). This insulation will run cooler than many standard insulations because of its dense, compact nature which aids heat conductivity. The material may be operated at 225 C (437 F) continuously. It has "zero" water absorption and its volume resistivity is greater than 10^{15} ohm per cu cm after prolonged soaking in water. It will not arc track. It is not attacked or decomposed by any ordinary chemicals. It was used in the original atomic energy plants for gaskets, pipe linings, etc., to handle very corrosive chemicals. Aqua regia has no effect on it. The alkali metals when molten will attack it.

There is no known solvent for teflon which has sometimes been used as a talking point, both for and against its use. Due to this characteristic, it cannot be securely bonded to any known material, but it can be sealed to itself by heating to 327 C (620 F). This insulation material has exceptionally low losses at all frequencies up to 30,000 megacycles.

Due to some part of the present manufacturing techniques, the tapes and sheet insulation have a variation in their dielectric strength. Microscopic impurities apparently cause points of low dielectric strength which has led to the application of the term "pin holing" to this weakness. Teflon is also subject to corona degradation; however, it is much better in this respect than varnished cambric which was used for many years for high voltage applications. Because of these two characteristics, it has not been previously recommended for commercial windings for voltages above 2300.

Another fluorocarbon material is available in a sheet or tape form and is known as kel-F. This material does not have the high heat stability of teflon; however, as improvements are made it will, no doubt, see increased winding application.

Other companies are also working on the fluorocarbon materials.

Another new insulation material that is just now getting into the pilot plant production stage is integrated mica. Very small particles of mica have a natural tendency to cleave to each other. Mica made from these small particles has a high dielectric strength, as well as good mechanical strength. With the advent of some of the newer high temperature bonding materials, it will soon be possible to use small particle domestic mica and other mica scrap to make acceptable mica sheets and mica tape.

There have been many improvements in conventional varnish resins as used for Class 'A' and Class 'B' windings. A family of materials classified by the chemist under the broad term "polyesters" are finding increasing use in the electrical insulation field. These materials can be made into literally solventless varnishes. The basic resins are made to go from liquid or fluid

TABLE III

Properties of Teflon

Property	Units	
Tensile strength, 77 F	psi	1500-2500
Elongation, 77 F	per cent	100-200
Flexural strength, 77 F	psi	did not break
Stiffness, 77 F	psi	60,000
Impact strength, Izod— 70 F	ft-lb	2.0
77 F	ft-lb	4.0
170 F	ft-lb	6.0
Hardness, durometer		D55-D70
Compressive stress at 0.1 per cent deformation	psi	1700
Coefficient of linera thermal expansion per degree F, 77-140 F		5.5×10^{5}
Thermal conductivity, 0.18 in.	Btu/hr/sq ft/ °F/in.	1.7
Specific heat	Btu/lb/ °F	0.25
Deformation under load, 122 F 1200 psi, 85 hr	per cent	4-8
Heat-distortion temperature, 66 psi	F	270
Dielectric strength, short-time, 0.080 in.	volts per mil	400-500
Surface arc-resistance	sec	700
Volume resistivity	ohm per cu cm	$>10^{15}$
Surface resistivity, 100 per cent R.H.	megohms	3.6×10^{6}
Dielectric constant, 60 cycles		2.0
10^{3} cycles		2.0
10^{6} cycles		2.0
10^{8} cycles		2.0
Power factor, 60 cycles		>0.0005
10^{3} cycles		>0.0005
10^{6} cycles		>0.0005
10^{8} cycles		>0.0005
Water-absorption	per cent	0.0
Flammability	in./min	non-flammable
Specific gravity		2.1-2.3
Resistance to weathering		excellent

state to a solid state by catalytic action instead of oxidation. Some of the types can be solidified more rapidly by exposure to heat alone, while with other types, the addition of a catalyst to the liquid starts the reaction. These polyester resins are produced in a wide variety of types. Some are of soft rubbery nature; some are of a harder variety, and others are hard and brittle. A number of chemical companies produce these resins. These resins became generally available as a result of our synthetic rubber production program. Now that this synthetic rubber production is being reactivated, some of the ingredients used in the polyester resins have recently been in short supply.

The advantages of these polyester resin materials over conventional varnishes and binder materials are homogenously, which means better heat conductivity, greater dielectric strength, and longer service life. Polyester resin material can be made to cure more rapidly than the best polymerizing type synthetic resin varnishes which means less processing time during coil or winding manufacture. Polyester compounds can be used for vacuum impregnation methods, dip or painting, or for potting. Polyester resins are being used today for final coil treatment, for glass tubing coating materials, for mica binders and for coil impregnation.

Improvements are being made in other materials used in electrical machines, as well as in manufacturing methods and electrical designs. These new materials include better magnetic core steel (grain oriented steel), which provides a reduction in the losses and means more efficient motors and generators.

Copper with small percentages of silver content is being used for heavy duty d-c machine commutators. This silver-bearing copper has a higher annealing temperature than pure copper. Silver-bearing copper is also being used for armature windings operating at high speeds and at widely varying load conditions because of its greater mechanical strength and higher annealing temperature.

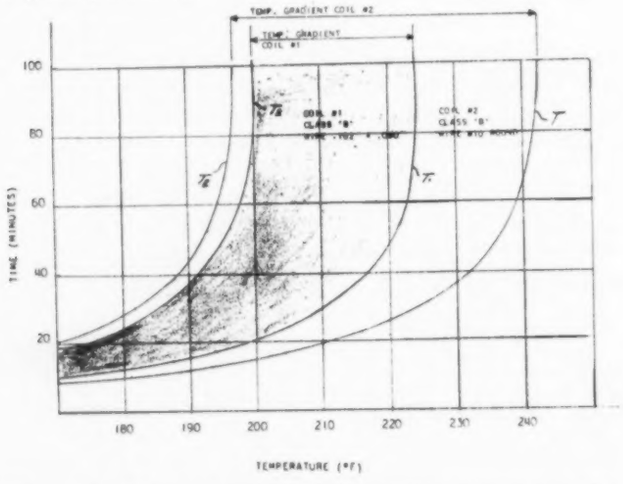


Figure 4 — Chart shows coil cell temperature versus time for two different type coils for a mill motor. T_1 is temperature inside coil and T_2 is temperature at surface of coil in slot.

New grades of brushes are being developed which have better commutating ability and longer service life. These electrographite brushes have greater transverse resistance and better film forming properties.

As to methods of winding application which contribute to lower overall cost, more molded insulation sections are being used in place of hand applied tapes and cut insulation. Here, of course, is a question of economics as always. The cost of the molding dies must be distributed over the number of pieces to be produced in a reasonable length of time. The cost per piece arrived at must then be compared with the cost of hand insulation methods. Here again some of the new polyester glass laminates look promising as a means of providing lower cost molded armature insulation sections. Comparatively simple dies can be used with some of these laminates.

Solderless terminal lugs and connections are being used more and more in electrical equipment. Some of these terminals are of the compression type. Brazed joints are also being used because of higher temperature resistance and the ease with which the connection may be made with resistance brazing equipment. In the field, brazed joints may be opened using aceteylene or gas torches. Another terminal connection method recently announced is called the cadweld process. This terminal connection fuses the copper terminal lug to the flexible cable or coil lead. The equipment required permits field application on motors located in the plant.

The secure anchoring of armature windings has always been of prime consideration to secure the greatest possible service life. Straight tension banding has been used for many years to secure armature windings. Heavy duty mill type motors have in addition to the final banding, had a temporary hot banding operation in a worthwhile endeavor to pre-season the armature coils and get a more rigid final band. Re-roll banding is now practical for mill type armatures. Re-roll banding methods permits the armature coils to be literally hot pressed on the core and is analagous to the pre-shrinking operation performed on cloth goods.

With the new insulating materials available today, it is possible to use large copper cross sections in modern windings for application to older machines. Larger copper cross sectional area results in a lower resistance and a reduction in the I^2R losses which we mentioned earlier. A simple test was set up to evaluate the performance of different conductor sections and insulations. This test utilizes armature coils for a standard 12-hp steel mill motor armature. Figure 4 shows the results of tests of two coils. One coil was wound with the original design round conductor. The other coil was wound with an oversize rectangular conductor. Both have standard Class 'B' mica and glass insulation. A thermocouple was wound into one slot portion of each coil with the thermocouple junction located next to the copper conductors. This internal thermocouple was connected to the indicating pyrometer at the top of the center panel. Another thermocouple junction was placed in the bottom of the slot into which the coil slot portion was fitted. These thermocouples were connected to the bottom instruments.

With these thermocouple arrangements the internal and external coil temperatures in the slot portion are measured. This gives some indication of the thermal conductivity of the insulation as well as a direct indication of the merits of different coil constructions.

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CRANE WHEEL TREAD CONTOURS

. . . . steel men should get together to study the action of different crane wheel contours so that factual information may be compiled . . . .

▲ FROM the very beginning tread contours of crane wheels have been discussed pro and con. There are today many men who can and probably will give many valid reasons why they believe one type contour to be better than another. In this paper each type contour will be discussed giving its good and its bad features, drawing some conclusions, but in no way trying to recommend a definite type contour.

Our company produces all types of tread contours, namely, straight or flat tread, radius tread, and taper tread wheels as our customers order. When difficulties arise, we study each application and make such recommendations as we believe sound to cure those difficulties. Needless to say, there are many factors that enter in to the successful or unsuccessful crane wheel operation. Some of the factors are listed as follows:

1. Building construction.
2. Crane runways.
3. Methods of securing rails.
4. Crane span.
5. Crane service (continuous or intermittent).
6. Crane speed.
7. Size of wheels.
8. Loads carried (central or all on one side).
9. Weather conditions (yard cranes).
10. Design of wheel drive.
11. Skidding of wheels.
12. How well contour holds its original shape.
13. Rail joints.
14. Crane maintenance.
15. Crane operator.
16. Abuse of equipment, etc.

Many wheels that gave satisfactory service for years are now giving trouble. This is due largely to changing operating conditions. The cranes are speeded up, the loads are greater to keep up with production schedules, etc. Years ago the tread contours used were the flat tread and the radius tread. The flat tread was used considerably more than the radius tread. Actually the flat contour used on rails where new or very little worn gives a spot contact; however, due to the loads and a certain amount of elasticity or deflection in both the wheel and the tread, the load is distributed over a larger area of both rail and tread. Flat tread wheels can compensate for a certain amount of misalignment in crane runways as there is, or should be, ample clearance between the rail and the width of the tread. There possibly is always the skewing of the crane encountered which causes abnormal flange wear, flange spread, and even flange breakage. The rail itself can be worn considerably at the edge of the head when operated with a crane in a skewed position. The only practical way misalignment can be corrected is to bump the crane against the stops or bumpers. Variation in crane wheel diameters is also a contributing factor to misalignment. We have seen cases where straight tread wheels actually cut the ball of the rail back to the web over a period of time. Naturally, during this severe wear on the rail many flanges of wheels were worn out.

When straight tread wheels are used and the runway alignment is bad laterally or vertically, the crane is bound to skew. Sufficient clearance over the ball of the rail is essential; however, it is questionable that the $\frac{3}{16}$ in. on each side, or $\frac{3}{8}$ in. total clearance, the generally accepted standard, is adequate. Experience definitely shows that $\frac{3}{8}$ to $\frac{1}{2}$ in. on each side, or more, is considerably better. Even with the greater clearance of $\frac{3}{8}$ to $\frac{1}{2}$ in. on each side of the rail head, the crane can skew if reasonable runway alignment is not maintained. With this condition, serious vibration, heavy bending stresses in the girders, and reduced wheel and rail life are encountered.

In making this survey on wheel contours the author has done extensive traveling and has discussed the subject with as many operating men as time would allow. The men using straight contour tread wheels have given many good reasons for their decisions. All feel that their wheels are giving good results because they do not experience serious flange wear, rail wear, or overall high crane maintenance costs. Crane alignment to them is not a problem.

Generally speaking, these men feel that if good maintenance is maintained, there will be no serious prob-

lems. By good maintenance they feel that it is imperative to keep the runway in good alignment, wheels must be mated very closely as to tread circumference, and a good crane operator employed, as well as good crane construction.

It was brought out in one discussion with an engineer in the Chicago area that he feels if the straight tread wheels are mated properly, and a minimum of ¾ in. clearance over the ball of the rail is used, there is no need for tapered wheels.

One of the most disturbing factors in this survey is the lack of factual data. In discussing crane wheels from Kansas City to the East Coast and from the Great Lakes to the deep South, factual data was practically nil. It boils down to opinions and possibly a great amount of actual operating experience. There are, however, a lot of straight tread wheels successfully used and those men using them are completely satisfied.

Tapered tread wheels are more widely used throughout the steel and general industry than straight tread wheels. In checking through our records at the plant for a given period, with figures based on 18-in. tread diam wheels and larger, we found that 908 straight tread wheels were furnished and 900 tapered tread wheels were furnished.

The survey shows that approximately 30 per cent of the tapered wheels furnished are used as idlers.

Therefore:
900 taper tread
30 per cent taper idlers

270 idlers
630 taper drivers

270 taper idlers
270 taper drivers

540 drivers and idlers with taper tread

Then:
900 taper wheels
540 taper drivers and idlers

360 remaining taper drivers that require—
360 straight tread idlers

908 straight tread wheels
360 straight tread wheels required as idlers for the 360 tapered drivers

548 straight tread wheels remaining. This breaks down to 274 straight tread drivers and 274 straight tread idlers.

Therefore, we find a total of 630 taper wheels used as drivers against 274 straight tread drivers.

Tapered tread standards as established call for a minimum of 1-½ in. clearance between the ball of the rail and the tread contour. The taper as standardized calls for 1-in. in 16 in. on the side. These standards are followed as closely as possible and generally speaking have worked out very successfully. There are, however, other designed contours being used. Tapers on the tread range from the generally accepted standard of 1 in 16 in. to 1 in 40 in. Actual survey indicates that they all work well, however, it is a known fact that the 1 in 16 in. taper accomplishes the aligning of the crane more rapidly than the lesser tapers. Many wheels are being produced with 1 in 18 in., 1 in 20 in. and 1 in 25 in. taper. There are definite cases where the lesser tapers have decided advantages over the 1 in 16 in. Generally, it should be understood that when using taper tread drivers, the idlers must have the same clearance over the rail head as the drivers.

The theory of the tapered tread wheels is that when a crane starts down the runway with the wheels making contact with the rails at points of equal diameter, the crane will maintain a straight line of travel. If, however, the crane gets into a twist due to the influence of slippage, bad runway alignment, or other causes—then the crane will start a weaving travel until the taper wheels are again to a point of equal diameters in contact with the rails. Due to the weaving action, there will be an equal wear on practically the full tread contour. Of course, it is very important to have sufficient clearance to allow the weaving action. Tapered wheels having insufficient clearance over the rail head will cause considerable difficulties in flange and rail wear, as well as the tendency for the crane to climb the rail and actually jump the track.

Actual tests at our plant indicated that a 5-ton crane of good construction equipped with straight tread wheels, caused considerable skewing and binding with considerable power being consumed to propel it. Alignment was maintained only by bumping the crane on the bumpers.

After changing to taper tread wheels, the crane alignment was maintained over a 700 foot runway with no binding of the flanges on the rail head. There was also a considerable reduction in the power consumed to propel the crane.

In all of my travel and discussion there were only two good bits of factual information gained. Both of these were in favor of tapered wheels.

In a glass company producing heavy plate glass, they have two cranes known as turn-over cranes. These cranes carry large racks that look like a series of hairpins with which they can pick up the 8 ft by 12 ft plates, turn them over, and set them in position for another grinding operation. The cranes are 5-ton capacity with 32 ft-6-¼-in. span running on 60-lb rails. The loading is not heavy, however, they are in constant operation.

Straight tread wheels installed on one crane in December of 1944 were replaced with tapered wheels in November of 1947 with a total life of 35 months. During the 35 months they had constant skewing of the crane, serious flange wear, and were breaking axles at the rate of one every six months.

Tapered wheels were installed in November, 1947, and are still in service today. They are in excellent condition, the customer reporting that not a single axle has broken in the 43 months of service. They specifically mention less maintenance and more production due to less downtime. The crane is able to keep up with production far better now that they have eliminated the binding on the flanges which slows the crane down considerably and necessitated going to the end bumpers to realign. The second crane is now equipped with tapered tread wheels also.

The other information that is also good comes from a steel mill in the eastern Ohio area. On a 4-wheel drive, 25-ton crane having a 98 ft span, tapered tread wheels caused a serious skewing with the reasons for the skew-

ing being undetermined. The wheels were then replaced with straight tread wheels and the skewing continued. It was thought that the trolley position had something to do with the skewing—so they tried changing the position of the trolley. With the trolley at the cab side, skewing was very bad; at the center skewing was still encountered but not so bad. With the trolley at the end opposite the cab the crane ran true. The next step in experimenting was to disconnect one of the motors and have only a 2-wheel drive. With straight tread wheels when the crane started out with good alignment, it maintained good alignment regardless of the position of the trolley. However, if it started out of line it stayed out of line. They then went back to the tapered wheels and a 4-wheel drive but slowed down the starting speed of the crane. It was set to start slowly and gradually gain speed and, with this setting, perfect alignment has been maintained ever since. Actually, this experiment shows that straight tread crane wheels will work as well as tapered wheels. The customer preferring tapered wheels from the alignment standpoint has decided to standardize on them.

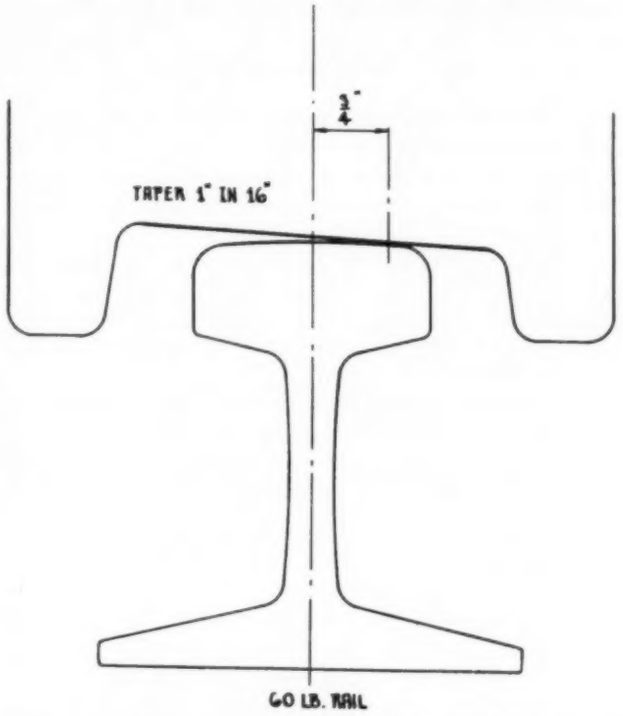


Figure 1 — When the 1 in 16 tapered tread wheel is used with a 60-lb rail, the load center comes close to the edge of the rail head.

It is important when using taper tread wheels that the loading on the rails be away from the extreme edge of the rail. Figure 1 shows a 60-lb. rail with a 1 in 16-in. taper wheel in contact. Note that the loading is coming fairly close to the edge of the head. This can cause a gradual mushrooming of the head and serious stress loading on the web of the rail. In this case it would be much better to use a 1 in 25-in. taper as shown in Figure 2. Here you will readily note that the loading is coming more nearly to the center of the ball. This will definitely lead to better rail life, less chance of rail breakage, less chance of rolling over of the edge of the head of the rail, and a generally better operating condition.

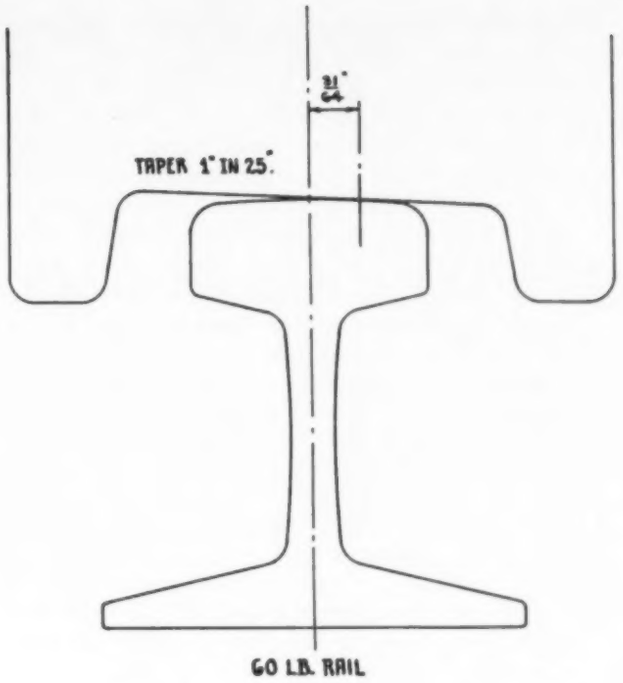
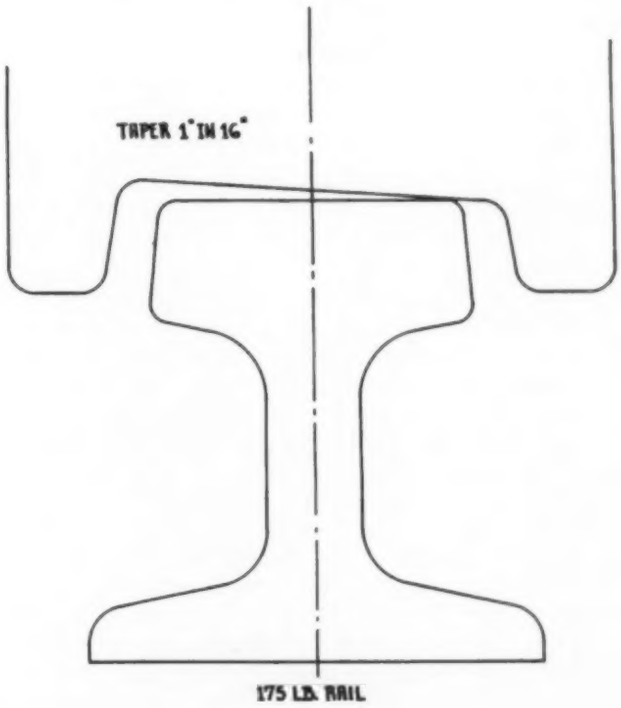


Figure 2 — By reducing the taper to 1 in 25 the load center approaches the web.

If a straight-headed rail is used as shown in Figure 3, certainly tapered tread wheels should not be used. This results in a serious wear on the rail along with serious stressing of the wheel contour. Tapered wheels on this type of rail will wear rapidly. We have seen cases where steps were actually worn in the tread contour.

Figure 3 — A tapered tread wheel should not be used on a straight-headed rail.



The general consensus of opinion of the operating men seemed to be as follows:

1. If the runway could be maintained as to gauge, straightness, and alignment, both vertically and horizontally, straight tread wheels would do a reasonably good job. This is practically impossible.
2. In view of the fact that the runways cannot be held in alignment, taper wheels will keep the crane straight.
3. When tapered wheels are used they are generally on cranes having a span of 60 ft or more and a capacity of 25 tons or less.
4. Straight tread wheels are used almost exclusively on the hot metal or mixing cranes and the ladle cranes. The reason for this is that these cranes are very rugged in construction and have a reasonably short span. They also operate on rails that are generally 175-lb and have either a flat head or a very large radius on the head.
5. The maintenance of equipment—both crane and runway—is of paramount necessity for the successful operation of the cranes equipped with either tread contour.
6. A good crane can be ruined by operating on a very bad runway, and conversely a good runway can be ruined by a crane that is in bad condition.

In view of the fact, as mentioned earlier, that there seems to be no factual information, the thought arises —would it not be beneficial for a committee to be set up to study many applications? The establishing of facts would be a tremendous asset to the men of industry, both young and old, in basing their decisions.

The Institution of Mechanical Engineers of Great Britain published a very interesting paper on the effect of tapered treads on the motion of overhead traveling cranes. This study appeared in the 1950 Proceedings of the Society. Their tests were on cranes of 7-½, 20, 60, and 140-ton capacity equipped with straight treads and two 15-ton and one 40-ton, and one general purpose crane of unknown tonnage equipped with tapered wheels. The taper wheels were 1 in 16 in. and all had a minimum of 2 in. clearance over the rail head. Their tests were very complete and the following conclusions were reached:

1. Taper treads are advantageous for reducing wear and tear on cranes and rails, by reducing the amount of contact between flange and rail and by providing a corrective action to free the wheel flanges from contact with the rail.
2. Tapered wheels require sufficient clearance over the rail head and also should include extra clearance to compensate for some misalignment in the runways. The amount of clearance will fluctuate, depending upon the amount of outage in the runway and other pertinent conditions in the crane.
3. Where conditions do not allow an adequate tread width as defined above, taper treads may cause more instead of less wear and should not be used.
4. Best results are obtained when taper wheels are driven by a single motor and a common axle or drive shaft. Taper wheels on independent wheel drives where travel is long should be avoided.
5. It is particularly important that the driving shaft shall be sufficiently stiff in torsion to avoid appreciably increased skew due to relative rotation of the driven wheel.

It is worth while to obtain a copy of this British study on crane wheels. It is interesting to note in the paper and discussion on tapered wheels by the British Society, that the minimum diameter wheels used were 27 in. and the maximum were 36-in. wheels. Generally, the steel industry in England does not use as heavy equipment as is used in this country. Their cranes are lighter, however, they use larger wheels. This is an asset.

In conclusion, it is again recommended that a committee of steel men be formed to study the action of taper tread and straight tread wheels so that good factual information can be compiled.

DISCUSSION

PRESENTED BY

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JOHN J. STOLZ, Chief Engineer, The Tool Steel Gear & Pinion Co., Cincinnati, Ohio.

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F. M. Highbarger: Gary Works has at this time 345 overhead type traveling cranes and 22 floor type traveling charging machines and pit cover cranes. I have been connected with cranes for approximately 46 years. In that time there have been many changes in the design of cranes and a large number of these changes have resulted in improved operating conditions, less maintenance, and longer life of cranes. As far as Gary Steel Works is concerned, the one change that did not improve conditions was the introduction of the taper tread wheel.

In the years 1938 to 1941, inclusive, Gary Steel Works purchased ten overhead cranes with taper tread wheels; these cranes ranged from 10-ton to 40-ton capacity. Within two years, it was necessary to remove the taper tread wheels and install straight tread wheels on six of these cranes. Four of the cranes were of 30-ton capacity, 87 ft-0 in. span 8-wheels, with double bridge drive. The weaving of the bridge on these cranes was constant and resulted in broken flange angles at ends of girders, broken end ties, end trucks, end truck supports, wheels, shafts, bearings and flexible gear type couplings. These cranes operated on locked runway rails.

When the straight tread wheels were installed, all of our troubles on these cranes were eliminated. (These cranes operate on runways 1400-ft long.) It was neces-

sary, at the time the straight tread wheels were installed, to change all of the rails' clamps to permit a ½ in. side float each way from the center line, or a total side float of 1 in. for each rail.

The four cranes that are operating on taper tread wheels (1 in 16) are of 10-ton capacity, 106 ft span, and were erected in 1938. Loss of wheels due to cut flanges and worn treads is just as great on these cranes as on any of the 29 cranes, having straight tread wheel, and operating on adjoining runways. The runway for these four cranes is in very good condition.

In all my experience on cranes, I have never seen a crane with radius tread wheels on bridge. I have been informed of one crane builder installing radius tread wheels on some cranes they built. I was also informed that it was necessary to replace these wheels with straight tread wheels before the cranes could operate.

On all straight tread track wheels the space between flanges must not be less than ¾ in. or over 1 in. greater than the width of the rail head. On taper tread wheels this space must be 1½ in. greater than the rail head.

Runway rails at Gary Steel Works are of three sizes: sections 10551, 13551, and 17551. All rails, including those used for trolleys, are heat treated; this, we find, increases the life of rails two to three times over that of untreated rails. The end of all rails are machined square and the first hole is drilled 2½ in. from the end of each rail. This gives a 5-in. center on these two holes when rails are butted together. Corresponding holes in the splice plates are then drilled 4⅝ in. centers. All holes are drilled slightly larger than the bolt used.

With this arrangement, the ends of rails are held tightly together. This eliminates any bad rail joints and prevents the hammering down of the rail heads at the joints, and also eliminates damage to roller bearings. We use a special rolled splice bar, which is without a flange, but is made to fit the slope on the rail flange and under side of the head. Welded rail joints are not used at Gary Steel Works.

Cranes equipped with taper tread wheels will weave on any runway, and the weaving will increase on runways that are out of line laterally, but they will not skew, and as runway rails on which taper tread wheels are used must be held rigid without any side float, the cutting of flanges will be excessive.

Cranes equipped with straight tread wheels will not weave on any runway and will skew only when there is oil on the rail, or possibly due to a wet rail on outside cranes, or when the drive wheels are not of the same diameter. There are two conditions which will cause continuous skewing of the crane, and one is that of drive wheels of different diameters (this difference does not have to be great). When wheels are of different diameter, the crane will skew with direction of travel. The other condition, and one that has given a great deal of trouble, is that of one end truck not being set at 90 degrees to the center line of the crane girders. With a misaligned truck the skewing is in one direction only and results in excessive cutting of all wheel flanges and damage to other parts of the drive.

When trucks are correctly aligned and drive wheels are of the same diameter and the runway rails permitted to side float, the cutting of wheel flange is eliminated, even if the runway is out of line laterally. Vertical misalignment causes very little damage to wheels.

Runway rails for taper tread wheels must be held rigid, without any side float, and for straight tread wheels all rails must be permitted to side float ½ in. each way. End float of all rails should be eliminated. This can be done by securely anchoring one rail at the center of each runway.

Eric Anderson: The application of tapered tread wheels is one which requires careful study and on attempting to apply them to older cranes, each crane must be considered as a separate problem. The tapered tread wheel requires a wider tread and in many of the older designs of cranes, there is insufficient clearance in the end trucks to allow for the wider wheel. The tapered tread wheel requires more end float for the crane, and in many of the older buildings there is not sufficient clearance between the end of the crane and the building columns to permit the use of a tapered tread wheel. In some cases, where original cranes are handling heavier loads than originally designed, track rails have been changed from 85 to 100 pound rails which imposes another problem. The tapered tread wheel must, of course, be heat treated. A soft tapered tread wheel will not work satisfactorily.

A 1 in 16 taper is more or less a standard, and will straighten the crane up somewhat quicker than the 1 to 18 or the 1 to 20 taper. While the lesser tapers are of certain advantages, the condition of the runway and the length of the runway must be taken into consideration before applying the lesser taper.

We have had one experience in the application of tapered tread wheels that I believe is worth mentioning. A 15-ton four wheel crane driven on all four wheels by two motors, one on each side of the crane, operated very satisfactorily for a number of years. However, due to change in operations, condition of the runway and possibly handling of greater loads, considerable difficulty was experienced in trying to maintain wheels and rails on the runway. It was decided to change the crane to a single motor drive and the two 37½-hp motors were removed and one 65-hp motor installed to drive two wheels on one side of the crane, at the same time the tapered wheels were installed. This crane has now been in operation for the best part of a year and our difficulties have disappeared.

I do not believe that we can say that tapered tread wheels are a panacea for all problems, as it was pointed out in Mr. Stolz' paper that there are many conditions governing the life of crane track wheels and rails, and in my mind each crane and installation must be considered as an individual problem.

F. M. Highbarger: I would like to ask the author of this paper if, in the great number of tapered tread wheels made by their company, was it possible that there was an excess of wear on the tapered tread requiring a large number of replacements?

John J. Stolz: First, I will say "no". We furnish a large number of wheels and we have had a number of wheels where we have changed from a straight tread to

a tapered tread and the wheel life is comparable or better than it had been on straight treads.

Now, I do not want you to misinterpret that statement. I am not taking a stand for one type or another. We make all kinds of wheels. One man I talked to stated that they changed completely to taper tread wheels, and had completely eliminated their trouble as far as skewing of the cranes are concerned. However, they definitely know that rail life is shorter.

As you can see, there was so little factual information available, however, to answer your question, I do not think that the use of the taper tread wheels has caused us to furnish any more wheels.

H. H. Angel: I would like to ask the speaker if he has had experience on the so-called straight tread where there might be a radius of 12, 18, or 24 in., in which there has been substituted for that wheel one that is perfectly straight in tread without any radius, and if so, have you heard anything about any difference in results?

John J. Stolz: I do have this information from one of the chief engineers of one of the large crane builders. He maintains that in no case would he recommend the use of the radius type tread if it were left up to him. In my own opinion on that, I feel that the radius tread wheel has by far a greater load carrying capacity because it does conform to the contour of the rail, and you get the benefit of full line contact across the rail rather than just spot contact. With this in mind it is reasonable to me that load carrying capacity is greater.

Many many years ago when Mr. Elmer Sawtelle read a paper before the AISE he had a slide which showed the effect on a straight tread, tapered tread and the radius tread wheel under static pressure. It proved that the radius tread wheel had much greater contact with the rail than either straight tread or taper tread wheels. However, as far as comparing the radius tread with the straight tread as to life, I have no information on that.

C. G. Dimitt: We would like to ask Mr. Stolz a number of questions.

Mention is made of variation of crane wheel diameters being a factor contributing to mis-alignment. Sometimes maintenance men faced with getting a crane back into operation in a minimum of time may change a defective wheel without checking the new wheel against the one to remain in service.

We are wondering if Mr. Stolz has heard of this condition during his investigation, and if so, how the situation has been met.

Mention is made of some of the heavier type cranes using straight tread wheels because these cranes are of very rugged construction and short span. This implies that the crane itself has less tendency to skew due to the ends being kept in square. For lighter cranes, construction using body fit bolts has been considered. Perhaps Mr. Stolz has some comment regarding effective means to keep the end tie connections square.

There are reports of some types of hardened wheels "spalling". Perhaps Mr. Stolz can give us the benefit of his experience along this line.

Mr. Stolz has tabulated taper wheel applications, indicating that only 30 per cent have been for idlers. The combination of taper drivers and straight idlers on the same rail would appear to cause considerable trouble with runway rails, particularly rails with high thin webs. What has Mr. Stolz' experience been regarding this combination of taper and straight treads?

Perhaps Mr. Stolz can say something about runway rail sections and rail splice connections with reference to their relation to good crane wheel performance.

John J. Stolz: In answering Mr. Dimitt's questions I would like to point out that if there is variation in the diameter of the drive wheels of as much as $\frac{1}{16}$ in., actually the circumference difference is approximately $\frac{3}{16}$ in. From this you can see that in slightly more than five revolutions of the wheels, an oversize wheel will have traveled approximately 1 in. greater distance. This will skew the crane, resulting in serious flange wear and rail wear. This is a maintenance problem and should be given consideration when installing the wheels. This condition was not brought out in my investigation; however, it is a serious factor in misalignment. Tapered wheels under this condition will work satisfactorily as they will weave until they reach a point of light diameters and will keep the crane in alignment.

Construction of the crane is important. The more rigidity built into the crane will lessen the difficulties of skewing. In my investigation, generally the lighter crane having long spans caused most of the difficulty.

The report of some types of hardened wheels spalling is correct. This is caused by several factors such as skidding, bad rail joints, exceedingly heavy loads, to mention a few. Experience and know-how in the manufacture of the wheels can eliminate to a great extent this trouble.

Straight tread idlers with tapered tread drivers seem to be used to a greater extent than all one type. There have been cases where rails broke in the web section. I believe, however, that the use of straight and tapered wheels on a crane does not cause premature failure of the rails. Naturally tapered wheels stress the rail head near the edge of the head which does cause some stressing in the web section. Straight tread idlers theoretically stress the rail directly on the center line of the rail which is basically a compression loading. I would believe that the combination of straight idlers and tapered drivers would cause less rail difficulties than having tapered wheels for idlers and drivers.

On the question of rail sections I believe the selection of rails is very important. They should not be of the high, thin web design. My belief is that the rails should be low in height and heavy of web section. There is little data on the splices and rail mountings used. Some rails are thermit welded without the use of splice plates; others are spliced with the regular splice plates. As to rail mountings, some rails are mounted rigidly and others are allowed to float. Largely all of the above is a matter of opinion. The type that seems to work the best under varying conditions is the type generally used by the maintenance personnel of the mills.

By GEORGE B. SCHEER
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Rectifier Applications
ON STEEL MILL DRIVES

. . . initial experience with a rectifier installation led to a decision to install many more. . . .

▲ TO discuss properly the application of rectifiers for steel mill drives, it would first be advisable to examine the historical growth of rectifiers as used at Fontana. When the plant was originally installed in 1942, four 1000-kw, 250-volt generators were purchased for constant potential use. Two of these were installed in what is called the power house and two in the plate mill, which was the only rolling mill facility that was installed at that time. The motor-generator sets in the power house were so sized that one motor-generator could handle the blast furnace, coke plant and the four open hearths that were initially installed. Also, either one of the motor-generator sets in the plate mill was of sufficient size to operate all of the constant potential auxiliaries, cranes, etc., that were required in the plate mill.

In 1943, considerable expansion was undertaken in that both a structural and merchant mill were added. The shortage of materials made it very evident that to meet our required dates of operation it would be necessary to use rectifiers rather than motor-generator sets. The amount of copper is reduced by 20 to 25 per cent when rectifiers are used in place of motor-generator sets, and the amount of sheet and structural steel is reduced by 50 to 55 per cent. We were not overly enthusiastic at that time about installing rectifiers because, although they have many advantages as has been enumerated in many papers, they also had certain disadvantages about which considerably less has been said. The efficiency on 250 volts is no great improvement as compared to a motor-generator set; arcbacks were frequent occurrences on many of the older multi-anode type rectifiers and they could not be said to have had a perfect operating record.

The individual tank type or ignitron which we purchased was then still relatively new in the steel industry. Rectifiers inherently are unable to dissipate regenerative current and require an external resistor. They have no inertia which, from a short circuit calculation, is beneficial on the a-c side. On the d-c side the rate of rise is greater than a motor-generator set which is a disadvantage. Having no inertia also introduces the disadvantage that the instant a-c power is removed there ceases to be any d-c power. The d-c voltage is not independent of the a-c voltage. A voltage dip in the a-c system is immediately reflected in the d-c voltage, although a voltage regulator will rapidly restore the voltage and only the most sensitive equipment will be effected by the dip.

At that time, in 1943, we purchased two 1000-kw and one 1500-kw, 250-volt rectifiers for the auxiliary power. The 36-in. mill and the structural mill proper were both driven through individual motor-generator sets. The merchant mill, which was to be driven by fourteen motors with a total installed horsepower of 7925 hp, was to be located in an area where motor room space was at a premium. It would have involved a very large motor-generator set to handle this equipment, and as time of shipment was excessive, it was decided to install a rectifier although no data was obtainable from any similar previous operations. The rectifier installed was rated at 2500 kw, 600 volt.

The operation of this rectifier has proven more than satisfactory. Momentary loads up to 6000 kw have been carried and the half hour demand has been 3000 kw. There was some difficulty encountered originally in maintaining the speed of the individual stands with respect to each other, but this was not a trouble of the rectifier, but that the motor operated rheostats used on the motor fields gave the motors too stiff a characteristic. The overall characteristic of the rectifier has proven extremely satisfactory. Although this rectifier is not used in parallel with any other piece of machinery, it has been and is still being used in series with generators.

In 1948, it was decided to expand the plate mill into a hot strip line. All hot strip mills in the United States heretofore have been powered by motor-generator sets,

although one installation had rectifiers operating in parallel with motor-generator sets, but in this case the motor-generator sets were used for starting the mill and the rectifiers operated at constant voltage. Based upon the past performance of rectifiers in the merchant mill and throughout the plant, this mill was installed using two rectifiers. There are three 5000-hp motors and one 3500-hp motor. The two rectifiers are 5000-kw each and are installed in the same motor room with the motors and are connected to the motors using a relatively short bus. No trouble has been experienced with starting up the lines with these rectifiers. There has definitely been quite a saving in cost installing the rectifiers instead of motor-generator sets. It should be noted that the percentage of kw of the rectifiers to installed hp of the motors is a minimum.

A favorable point in the use of rectifiers is the large momentary overload capacity. Calculations of the rolling schedule show that this would amount to about 225 per cent of the rms load. This condition is obtained with a heavy size plate just after the plate reaches the last stand and before it leaves the first stand.

Calculations showed that for the condition of reducing from $\frac{5}{8}$ in., 54-in. wide plate to $\frac{1}{8}$ in. with a delivery speed of 1300 fpm, the peak loading on the rectifier would be 21,000 kw and the rms value of kw would be 9700 kw for a tonnage of 200 tons per hour.

On a $\frac{5}{8}$-in. plate, 48-in. wide with a speed of 1300 fpm, calculations show an rms load of 8500 kw will be imposed on the rectifier. Actual tests made show the load is 7500 kw which indicates the rolling data are based on conservative conditions and some extra margin of power is available.

There are certain unique features in designing and operating a motor room using rectifiers that require a more detailed discussion.

Motor room ventilation can, if not carefully held in check, cost an excessive amount to both install and operate. Ventilation consists simply of pushing a mass of air through the motors and generators, through an air-to-water heat exchanger, through filters if used and then recycling the air. With a rectifier, the water can be sent directly through the transformer and back into the cooling water system. Motors and generators have not yet been put into steel mill use that can be cooled directly by water. The d-c drive motors are, of course, ventilated by air. The ventilation requirements of the additional four stands for the hot strip mill consist of six fans with a total capacity of 200,000 cfm at 3-in. water plus 50,000 cfm capacity at $\frac{3}{4}$ in. water for make-up air, all requiring about 175 hp in motors. If motor-generator sets had been used, an additional 100 hp would have been required. The ventilating equipment cost, including the heat exchanger and make-up equipment, was $61,000, but would have been $100,000 if motor-generator sets had been used. Power would have cost $3000 to $4000 per year extra to operate the additional fans.

Space saving, foundation cost and installation cost are other factors where rectifiers have an advantage. Originally it was intended to use oil-filled air-cooled transformers for the rectifiers and locate them immediately outside the motor room. This would have had the advantage of lower first cost, a saving in motor room space and an elimination of the use of cooling water. This would have been an important saving at Fontana as all the water is recirculated through cooling towers. However, a slab yard is located next to the motor room and a railroad track was immediately outside and could not be moved.

As a result, water-cooled transformers had to be used. The floor space that can be charged to the rectifiers and their transformers amounts to 1825 sq ft. If the transformer could have been located outside, the floor space would have been reduced to 1325 sq ft. At $30.00 a sq ft for a motor room, this would have amounted to a saving of $15,000 if transformers could have been located outside. A motor-generator set, however, required the same area that was actually used so neither a saving nor a loss was made.

The rectifier is static and needs no special foundation other than that required to physically support it. A motor-generator set rotates and not only needs the physical support, but enough mass in the foundation to dampen any vibration. The extra cost of foundation, if motor-generator sets had been used, would have amounted to an additional cost of $25,000.

The location of the transformer for the rectifier in the merchant mill was a more complicated problem. Although space at Fontana does not appear critical, the installation of a rectifier transformer outside a motor room means that a subsequent mill would otherwise have to be built 20 ft farther away. Unlike a standard transformer, a rectifier transformer, due to its many buses to the rectifier, has a very limited space where it may be located. It could not be put at the end of the merchant mill motor room so it was finally located in a pit on the mill side of the motor room. To have located the transformer inside the motor room or to have used motor-generator sets would have required 10 ft extra throughout the whole length of the motor room at a cost of $30,000.

Operating cost in a motor room consists of essentially the cost of power, operating labor and maintenance. The relative cost of power is simply an inverse function of the efficiency. The efficiency of a motor-generator set is about 92 to 94 per cent. It drops off as the load decreases and shows a sharp drop at light loads. Efficiency of a rectifier is based fundamentally on two items. The transformer and reactor have a high efficiency of about 99 per cent and it stays relatively high at light loads. The old type rectifier had a voltage drop in the arc of about 25 to 30 volts while the ignitron type has a voltage drop of 17 to 19 volts. As the inefficiency is primarily the ratio of this arc drop to the d-c voltage, it can be seen that the efficiency of the ignitron rectifier is quite good, particularly for the higher d-c voltages used in a hot strip mill. The efficiency also is better maintained at light loads than for a motor-generator set.

Operating labor is considerably less than for a motor-generator set. This is particularly true as the motor-generator set is at an isolated location and the motor-generator set would require an operator, whereas a rectifier can be treated as a transformer. A rectifier can be operated with little or no supervision and suitable controls can be so used that if trouble develops in the rectifier, it can be removed without difficulty. A generator should have visual inspection of an operator to detect impending trouble, and if an operator is not provided it is possible for the generator to develop serious

trouble which will require costly repairs. For a hot strip mill motor room, however, this is of no particular advantage as operators are necessary in a motor room under any conditions.

Maintenance of a 1000 kw, 250-volt motor-generator set requires 198 man hours per year of which almost half is for checking lubrication. Down time was 76 hours per year, about a third being due to cleaning and another third being due to commutator and brush maintenance. Labor cost amounted to $558 and material cost $125. The same size rectifier required 70 man hours per year of maintenance which consisted of dusting, inspecting and general cleaning. Down time was 46 hours per year. Labor cost was $197, and material cost, which consisted mostly of distilled water, was $115; making a total of $312.

Thus, a rectifier as compared to a motor-generator set required but 35 per cent as much labor for maintenance, 90 per cent as much material and had a down time of 61 per cent. The dollars may not be great but the percentages are important. They are typical for all of the rectifiers.

A rectifier is at a considerable disadvantage regarding power factor. On a 10,000-kw rectifier at 91½ per cent power factor, approximately 3000 kva in capacitors are required. This would cost approximately $45,000. To install capacitors induces problems of resonance in the electrical circuits. Capacitors also induce a problem in voltage regulation. A synchronous motor can be set with an adjusted field strength for a given voltage, and will pull the line voltage toward this value or can be set for any combination of voltage or power factor control. A capacitor will take a constant rkva and will almost always tend to raise the system voltage, depending on the total load, reactance and resistance of the circuit. Although a voltage regulator can be used to bring the capacitors in and out of the circuit, this is a step affair, is not instantaneous and requires an indication or change of voltage before it can function. At Fontana capacitors were not used. The plant operates at about 97 per cent power factor and there is but little saving to be gained by improving this power factor.

In a d-c generator the voltage is controlled by the field current; in a rectifier by retarding the firing. This means a very small current is required to control the voltage of the rectifier as compared to field current of a generator so a static saturable reactor type of regulator can be used without tubes or rotating parts.

Changes of load and the resulting system impact are of the utmost importance, and yet are the least discussed feature of rectifiers.

The electric motor is a convertor of energy from the electrical to the mechanical system. It "sees" or "feels" the energy requirements of the mechanical system and draws on the electrical system for this energy. An induction motor or a d-c shunt motor does this by slowing down. Although a large mechanical force may be applied to the motor, the electrical system knows nothing about it until the motor slows down. Its only knowledge of the energy it has to supply the motor is the motor's speed. Because of this, and the inertia of the rotor, a sudden mechanical impact is not immediately reflected into the electrical system.

A synchronous motor "sees" its load by the relative position of the rotor poles, which are mechanically rotating about its shaft or axis; and the stator poles which are electrically rotating at the same speed. When the poles are in direct alignment, there is no electrical power being taken into the motor; when shifted about 40 or 50 electrical degrees, the motor is taking full current. The motor has inertia and to make this shift the rotor has to momentarily slow down and then speed up. The time it takes to do this is the time of delay of reflecting the load of the mill onto the electric system.

A rectifier has little inertia. The action in the tubes themselves is simply a movement of ions.

From the above it would seem that an ingot or plate entering the mill would have a very serious effect on the voltage of the a-c system. A few factors mitigate this to a point where it is comparable to that of a synchronous motor-generator set. First, the mill has four stands and the plate enters each stand at separate times. A 10,000-kw demand is thus broken up into four 2500-kw increments. Secondly, the mill motor furnishes a large portion of the inertia effect even when used in conjunction with a synchronous motor-generator set or a rectifier. A chart is taken when a rectifier is used and shows the four definite steps for entering and leaving of the plate. The individual steepness of the curves would be decreased if an induction motor were driving a generator, but the overall slope of the four parts would not change, nor would the maximum peak as this is a function of the speed of rolls and distance between them.

Acceleration of a mill presents no operating problem. Deceleration is, because of a rectifier's inherent inability to regenerate a-c power, difficult and should not be used where more than one stand motor is working on a strip.

It is questionable whether rectifiers should ever be used to furnish power for a continuous cold mill or any mill where metal is being worked on by two or more motors, and the mill must be accelerated or decelerated with metal in the rolls. Also, a single stand mill that requires frequent and rapid reversals is hardly a proper application for a rectifier as it could not regenerate the power back into the system, and the excessive peaks would be very severe on the power system. A rectifier can do the work of a synchronous motor-generator set but does not have the inertia characteristics of an induction motor-generator set with a flywheel

One of the greatest advantages of rectifiers is the great overload capacity. It is, of course, possible to overload any piece of electrical equipment. When a generator is overloaded, it may flash over. This will mean a shutdown of anywhere from the time necessary to inspect and restart the motor-generator set to the time necessary to repair any damage done to the commutator and the brushes. The equivalent trouble for a rectifier is an arc back. A considerable number of arc backs have occurred at Fontana but it has caused but few interruptions.

The 2500-kw rectifier for the merchant mill arced 48 times in one year. When this happens the anode breaker that cleared the short will reclose as many as three times in two minutes and then will lock out and sound an alarm without completely shutting down the rectifier. A very minimum of production time is thus lost.

We hesitated about putting the first 1000-kw unit in. There are now 17,000 kw installed and the next expansion will add more in rectifier capacity.

DISCUSSION

PRESENTED BY

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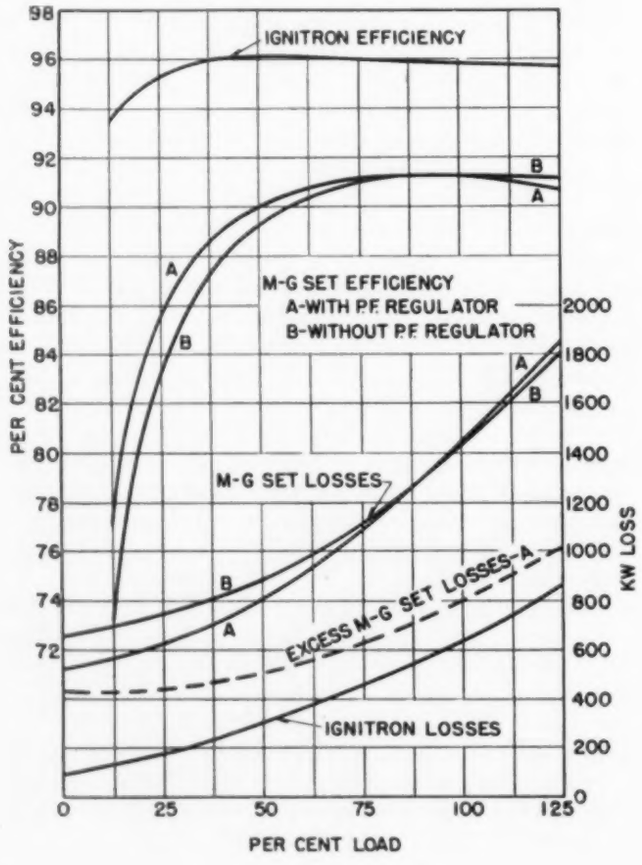
W. R. Harris: Mr. Scheer has presented a very useful and interesting paper. It has added value since it comes from an operating man rather than from a manufacturer. The data given on costs will prove to be very helpful to others when a decision must be made as to rectifiers versus motor-generator sets. Some time ago we had occasion to make a thorough analysis of the costs of a 10,000-kw, 700-volt ignitron rectifier installation versus a similarly rated motor-generator set. The total saving through use of rectifiers was approximately $100,000. This was divided approximately half and half between equipment price, and savings on installation details such as foundations, ventilation, etc. This amount of saving for such large installations will vary over a considerable range depending on local conditions.

Figure 1 — 15,000-kw, 700-v ignitron rectifier is compared to 90 per cent power factor synchronous motor-generator set.



It is difficult to make a general rule. The best practice is to analyze each case so that values are certain.

To supplement the data on efficiency refer to Figure 1 which is a comparison of the efficiency and losses of a 15,000-kw, 700-volt ignitron rectifier and a 15,000-kw, 90 per cent power factor synchronous motor-generator set. The rectifier has a decided advantage in efficiency, particularly so at light loads when there would be no strip in the hot strip mill finishing stands. The dotted curve shows the excess motor-generator set losses which are approximately 400 kw at no-load and 800 kw at full load. If we assume an average loss of 600 kw over the operating cycle, 7000 hours per year operation and a power cost of 1¢ per kwhr, the saving in power bill per year by using rectifiers is $42,000.

Advantages such as these have made the rectifier the accepted standard for 250-volt, d-c mill auxiliary power and it has supplanted motor-generator sets almost entirely for new installations and additions in power to existing installations. It is also finding wide use in variable voltage applications such as those for hot strip mill finishing trains where except for starting conditions a constant potential direct current is required. Table I shows nine such installations made by our company in recent years. The total kilowatts of these installations is 88,000. The total kilowatts for this type of application supplied by all U. S. manufacturers including the above is approximately 132,000. It will be noted that the first mill supplied entirely by rectifiers was the 2500-kw unit on the merchant mill at Kaiser. From this we can understand Mr. Scheer's remark that he was uneasy on the first installation. It takes courage to pioneer.

Rectifiers operate at lagging power factor whereas motor-generator sets can be designed to operate at unity or leading power factors. On large installations, the power factor must be carefully watched although with the synchronous capacity usually installed on roughing stands and on the motor-generator sets for other mills, there is usually no difficulty. Figure 2 shows the power factor of a 1500-kw, 700-volt rectifier under different operating conditions. The top curve shows the power factor with the unit designed for 700 volts full load and no regulator applied. The second curve shows the power factor with the voltage maintained flat at 700 volts with a voltage regulator. The regulator retards the firing angle at light loads which causes the drop in power factor.

As the voltage on a rectifier is reduced by change in firing angle or so called "phase control," the power factor drops almost in direct proportion to the reduction in voltage. For example, a 12-phase rectifier has a power factor of approximately 96 per cent at full voltage. This same equipment when operated at ½ voltage by phase control, will have a power factor of approximately 48 per cent. The lower curve of Figure 2 shows the power factor with the voltage reduced to 655 or 93.6 per cent. It will be noted that the reduction in voltage is 6.4 per cent and the reduction in power factor is also approximately 6.4 per cent at full load.

H. W. Poole: Mr. Scheer has given us an excellent account of his experience with mercury-arc rectifiers. We are indeed glad to have the factual evidence which Mr. Scheer has produced and I think the figures on savings in maintenance are particularly significant since they are more favorable than had been anticipated.

TABLE I

Mercury Arc Rectifiers for Main Roll Drive Service

No.	Year installed	Units	Total kw	Application	Purchaser
1*	1942	1-3000	3,000	10-in. hot strip mill	American Steel & Wire
2	1943	1-2500	2,500	Merchant mill	Kaiser
3*	1950	1-4000	4,000	79-in. hot strip mill	Bethlehem
4	1951	3-5000	15,000	66-in. hot strip mill	Usinor—France
5	1952	3-5000	15,000	56-in. hot strip mill	Voest—Austria
6	1951	3-6000	18,000	80-in. hot strip mill	Sollac—France
7	1952	6-4000	24,000	80-in. hot strip mill	U. S. Steel
8*	1952	1-5000	5,000	80-in. hot strip mill	Armco
9	1952	1-1500	1,500	Assel tube mill	Ohio Seamless
		Total	88,000		

*Rectifiers operate in parallel with motor generator sets.

Mercury-arc rectifiers are the accepted standard for 250-volt, d-c service in the modern steel mill and they are rapidly becoming the first choice for the main drives of continuous mills where regeneration of power and frequent changes in d-c voltage levels are not required. For main drive applications where d-c voltages of 600 volts and above are encountered, the favorable efficiency of the rectifier is particularly important. The following example illustrates the differences in losses between synchronous motor-generator sets and rectifiers applied to a hot strip mill bus. Three such 7000-kw, 600-volt rectifiers operating for 7000 hours per year would give an annual power saving of approximately 6,000,000 kwhr, or approximately $42,000 per year at 0.7 cents per kwhr. This saving is worth careful consideration.

In designing a large adjustable voltage rectifier for a main roll drive, there are a few problems faced by the electrical manufacturer which may be of general interest.

Of primary concern is the effect of the large amount of phase control required upon the performance of the rectifier. It is a well-recognized fact that large amounts of phase control, such as are required for 100 per cent voltage adjustment of a rectifier, can impose an increased duty on the mercury-arc rectifier. This increased duty can lead to increased likelihood of arc-back, if not properly compensated.

There are three conventional means available to the designing engineer for compensating for the increased duty, when large amounts of phase control are involved:

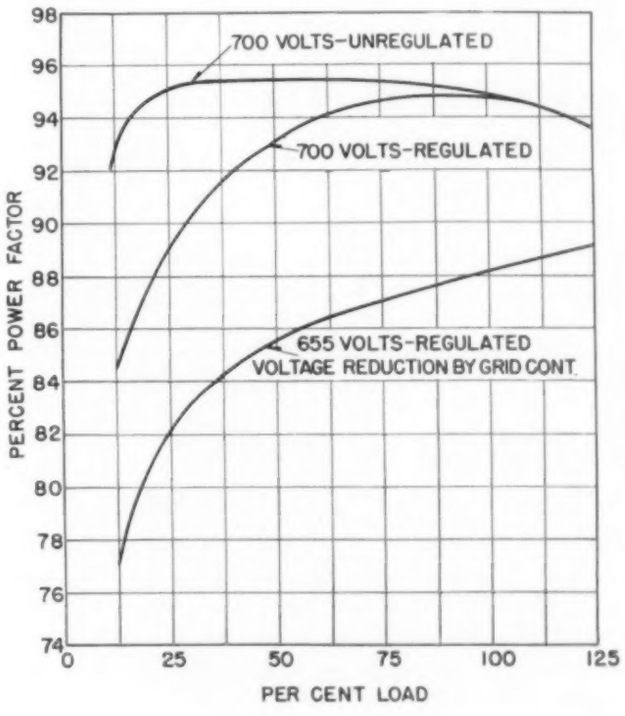
1. Improve the design of the grids in the rectifier.
2. Use commutating reactors.
3. De-rate the rectifier.

In the case of the two 5000-kw rectifiers mentioned by Mr. Scheer, the first two effective tools were used by the designer. A standard rectifier unit designed to provide constant voltage with a narrow range of phase control has just one grid for each anode. In this instance, double-grid construction was used instead, because during the period of starting up the d-c motors from rest, the d-c voltage had to be continuously adjusted at any value between zero and full rated output voltage. The use of a second grid in each anode of the Kaiser rectifiers increased the amount of baffling, improved the rate of deionization at the end of the conduction period, improved the accuracy and reliability of grid retard of current conduction through the rectifier, and resulted in a substantial improvement in rectifier performance under wide angle of phase control.

Commutating reactors were also used to reduce the likelihood of arc back. Commutating reactors, as employed in rectifier circuits, are non-linear in characteristic and arranged so that reactance is present in the anode circuits for just a few milliseconds to coincide with the end of conduction of current by each anode, each cycle.

There was no need to de-rate the rectifiers for this application after the engineers had made full use of double-grid construction and commutating reactors.

Figure 2 — Power factor of 15,000-kw, 700-v ignitron rectifier.



In closing, I would like to call your attention to one recent advance in the art of mercury-arc rectifier design. I have reference to the pumpless rectifier which is now available. The rectifier does *not* require any vacuum pumping equipment. Such units are now in production in 1000-kw, and 1500-kw, 250-volt sizes for constant potential power supply and 3000-kw, 600-volt sizes for main roll drives. Larger units will be made available for main roll drives when required.

E. F. Donatic: Mr. Scheer should be congratulated on his courage in installing the first rectifier with full range voltage control so that the mill could be brought up from rest. On the other hand, he had an advantage in not being an old time steel mill engineer, and thereby being unfamiliar with steel mill traditions, which were opposed to rectifiers.

I do not think he gives the rectifier enough credit for economical operation on light loads. This is particularly true on mills such as our 86-in. mill. This mill operates at less than 50 per cent load factor, and the power loss difference between a motor-generator set and a rectifier would be quite a bit.

When the large strip mill rectifiers were contemplated, we had some concern as to the voltage regulation and its effect on the drive motors with steel in the mill. We are at the end of a long power line, and sudden load peaks such as a hot strip mill will cause some voltage disturbance.

This was discussed in a previous paper (Rectifiers in the Steel Industry, by F. Mohler, 1945 Proceedings AISE, p 558) by Mr. Porter of the Steel Co. of Canada. In fact, that was the reason given by Mr. Porter for using motor-generator sets. After we started the 86-in. mill, we had some 14,000-kw peaks, which, according to the power company, caused line voltage disturbance to their system. On the other hand, our 600-volt bus remained constant in the strip mill, and our 600-volt bus in the merchant mill also operated satisfactorily, rolling narrow strip.

This proves that the d-c voltage regulation is very good even with adverse fluctuation on the a-c circuit.

As far as maintenance goes, I do not think there is any comparison. A rectifier is simpler and less liable to serious trouble, and has no large bearings or brushes. I have been working with rectifiers since 1936, when Republic Steel put in the first steel mill rectifier in South Chicago. I definitely am in favor of them whenever they can replace motor-generator sets.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Monday, November 24, 1952 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Birmingham's Industrial Water Problem," by S. D. Moxley, Vice President, American Cast Iron Pipe Co. and Co-chairman, Industrial Water Committee of Birmingham Chamber of Commerce, Birmingham, Ala.

Thomas Jefferson Hotel, Birmingham, Ala.

▲

BUFFALO SECTION

Tuesday, November 11, 1952 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Reversing of Hot Strip Mill," by D. E. Abell, Control Engineer, Westinghouse Electric Corp., Buffalo, N. Y.

Sheraton Hotel, 715 Delaware Ave., Buffalo, N. Y.

▲

CHICAGO SECTION

Tuesday, November 11, 1952 — Dinner 6:15 P.M., Meeting 7:45 P.M.

"Magnetic Amplifiers in Control Circuits," by Ray Moore, Control Engineering Section, Westinghouse Electric Corp., East Pittsburgh, Pa.

Phil Smidt's Restaurant, 1205 N. Calumet Ave., Hammond, Ind.

DETROIT SECTION

Tuesday, November 11, 1952 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Refractories-Application and New Methods," by J. D. McCullough, Chief Engineer, Refractories Div., The Babcock & Wilcox Co., New York.

"Past Chairman's Night"

Dearborn Inn, Oakwood Blvd., Dearborn, Mich.

▲

PHILADELPHIA SECTION

Wednesday, November 5, 1952

INSPECTION TRIP — Bethlehem Steel Co., Bethlehem, Pa.

Group will assemble at Bethlehem Steel Club, Hellertown, Pa. Busses will leave at 8:30 A.M.

▲

PITTSBURGH SECTION

Monday, November 10, 1952 — Dinner 7:00 P.M., Meeting 8:00 P.M.

"The Coordination of Control and Drive Equipment for E.O.T. Cranes," by D. C. McCrady, Superintendent, Electrical Department, The Steel Co. of Canada, Ltd., Hamilton, Canada.

"The Selection of Bridge and Trolley Controls," by W. C. Rhine, Application Engineer, Cutler-Hammer, Inc., Milwaukee, Wis.

"Recent Developments in the Field of Industrial Crane Bridge Braking," by John W. Kourik, Engineer, Wagner Electric Corp., St. Louis, Mo.

University Club, University Place, Pittsburgh, Pa.

By W. R. HARRIS
Manager, Metal Working Section
Westinghouse Electric Corp.
East Pittsburgh, Pa.

OPERATING EXPERIENCE WITH REGULATING SYSTEMS FOR THE STEEL INDUSTRY

. . . . four types of regulators are commonly used by the steel industry: electro-mechanical, electronic, rotating and magnetic amplifiers . . . . the selection of the proper type will result in the best operation . . . .

▲ THE steel industry probably uses more automatic regulating equipment in conjunction with electric drives than any other industrial group. There are a number of good reasons why this is so.

1. The desire for high tonnage.
2. The tremendous capital investment involved makes necessary the use of any means of increasing production and improving quality. Regulating equipment is usually a very small percentage of total investment.
3. The increasing use of continuous mills and processing lines, and the trend toward higher speeds makes use of regulating equipment mandatory. The operator, no matter how expert, is not physically or mentally capable of performing many of the complex functions required.
4. Elimination of the uncertain or variable "human element" in striving for continuous duplication of results.

To choose regulating equipment which will do the best job now and in the future, the application engineer must know what is available, what operating experience has been, and what the trend for future regulators may be.

HOW REGULATOR TYPES OPERATE

Figure 1 shows schematically the four types of regulating equipments available for heavy duty mill applications. All are arranged to regulate the voltage of a d-c generator. The electro-mechanical regulator uses a spring as a fixed reference. The regulated quantity is measured by a solenoid which acts in opposition to the pull of the spring. Any variation in the d-c generator voltage will unbalance these pulls and move the rheostatic element which changes the exciter voltage in the direction to return the generator voltage to the proper value. To provide accurate regulation these differences in forces must be very small and the rheostatic element must be designed accordingly.

The electronic regulator uses a reference voltage as a fixed standard with the voltage of the d-c generator bucked against the standard. Any difference in these voltages applies a bias to the grid of the vacuum tube. The vacuum tube then acts to change the firing point of the grid controlled thyratron tube which supplies power to the d-c generator field. Thus any variation in d-c voltage will cause a corrective change in its shunt field strength through action of the electronic regulator.

The rotating regulator uses a reference voltage applied to the pattern field as a fixed standard. The voltage field measures the d-c generator voltage and is connected in opposition to the pattern field. Any difference in generator voltage will disturb the balance between the two fields and change the rotating regulator voltage in such a direction as to return the d-c generator voltage to its proper value. Such regulators are frequently applied with the reference voltage and generator voltage bucked against one another and the difference applied to a single rotating-regulator field. The third rotating-regulator field is a self-energizing winding which is often used to improve steady state gain. It lowers the difference required between the other fields and gives more accurate voltage regulation.

The magnetic amplifier has a pattern winding and a voltage winding which are very similar to rotating-regulator fields. Small differences in the strength of these windings will saturate the magnetic cores and cause large changes in the output windings. The alternating current of the output winding is rectified and applied as a d-c voltage to the generator shunt field. Thus small changes in strength of the pattern and voltage windings can be made to exert large corrective

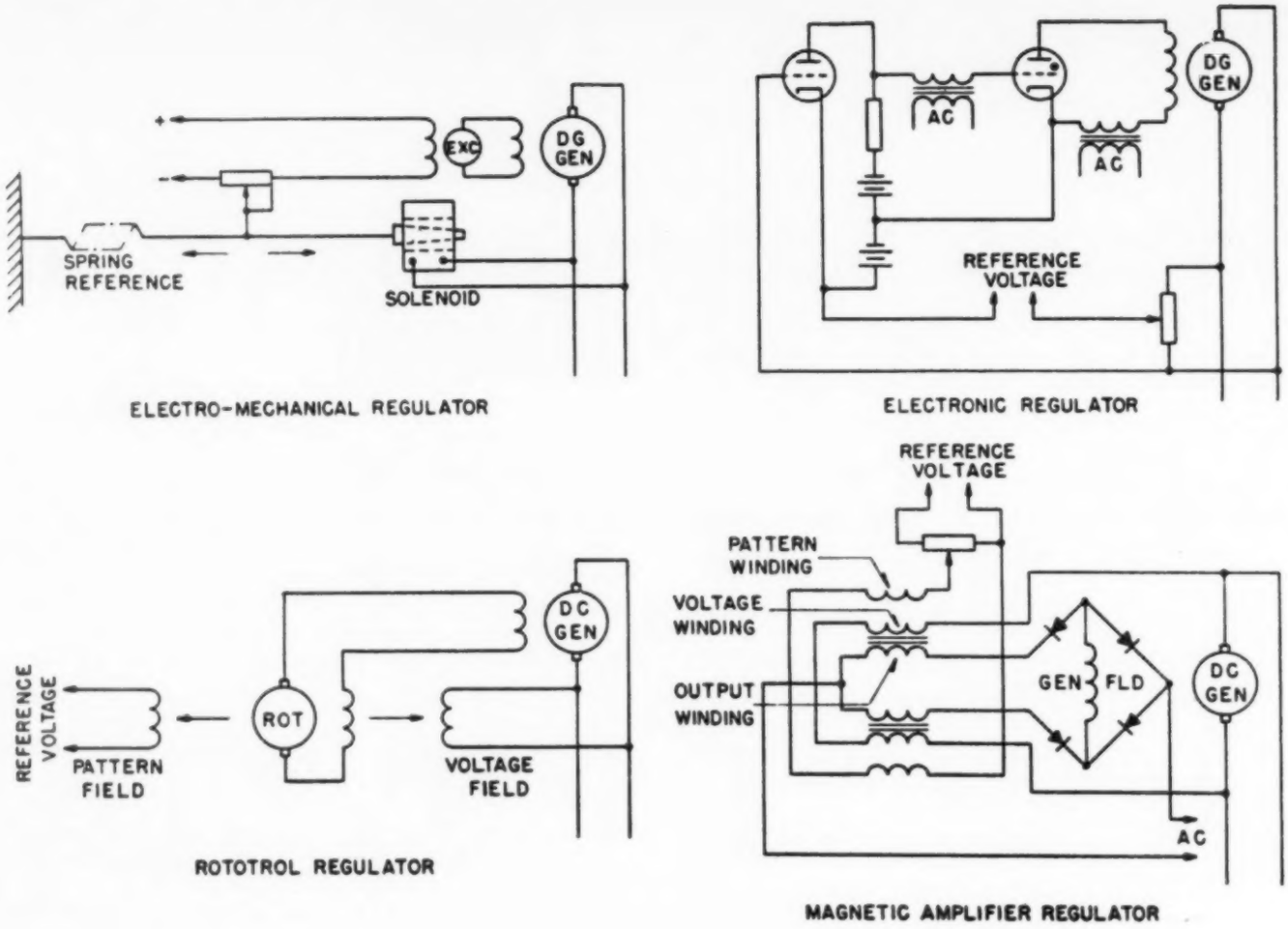


Figure 1 — Schematic diagrams show four classes of regulating equipment in present day use.

forces to the generator field and to hold the generator voltage within narrow limits.

It is important to bear in mind that the regulator is merely one component of a total system. To obtain the most from these systems, good regulator design must be coupled with good basic motor and generator characteristics, and good relaying — all tailored to fit the particular application. The regulating element, no matter how excellent, cannot fully compensate for improper characteristics in other parts of the system.

REGULATING SYSTEM CONSIDERATIONS

With good system design there are several points to be considered in selecting the proper regulating system. The main points are:

1. Steady state accuracy requirements.
2. Transient response requirements.
3. The degree of stability.

Regulator gain or amplification is an important factor in each of the above three. The gain in voltage around the system is a more useful factor than the power gain which has been highly touted in some advertising, merely because of the astronomical figures involved. For instance a system for control of a 3000-kw generator has a voltage gain of 50 and a power gain of 15,000,000.

Figure 2 will bring out the importance of voltage gain on steady state accuracy. Here we have the most simple regulating system possible where the field of a d-c generator is connected between its own terminals and a reference voltage. If the generator voltage deviates from the reference voltage, a current will be circulated through the generator field in a direction to reduce the deviation. The system voltage gain "A" is defined as follows: If one volt on the generator field produces 50 volts at the generator terminals, the gain would be 50:1. In the tabulation the full load resistance drop in the generator has been taken as 10 volts for a generator rated at 100 volts output. The no-load terminal voltage of the generator has been kept constant at 100 volts. When full load is thrown on the machine, the terminal voltage drops depending upon the gain of the regulating system. For instance with no regulator connection, the voltage would drop 10 volts which gives a 10 per cent error. With a gain of 1 this error is cut in half to 5 per cent. With a gain of 10 the error is less than 1 per cent, and with a gain of 100 the error is less than 1/10 of 1 per cent.

It will be noted that the terminal voltage is quite different from the reference voltage for the lower values of gain. Also the terminal voltage at full load for low values of gain drops appreciably. These two factors can be improved by various circuit arrangements such as a

basic excitation field connected across the reference voltage to give approximately the correct generator voltage, or the use of compounding or self-energization to increase the generator voltage as the load is applied.

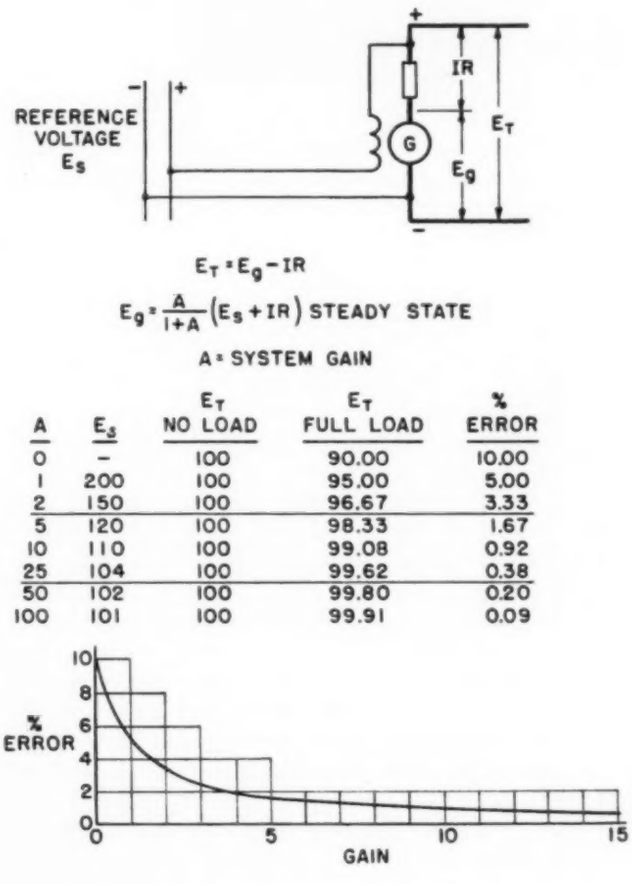
The per cent error versus gain curve shows clearly a diminishing return in accuracy as the gain is increased. Most applications are satisfactory if an error of approximately ± 1 per cent is not exceeded. In actual practice, the steady state gains of the various types of regulating systems varies between 5 and 25 with a few high performance regulating systems such as those for individual generator tandem cold reduction mills, and the all electric flying shear exceeding 50:1.

The system gain is also highly important to the transient response. In a single time delay such as that shown the machine time delay for no regulator connection is L/R which is the field inductance divided by the field resistance. If gain is introduced by the connection shown, the time delay in seconds becomes $\frac{L}{R(A+1)}$. Thus for a gain of 1, the time delay is cut in half and for a gain of 10 it is less than 1/10 of the original value. With a single time delay the system is inherently stable and cannot oscillate. Thus no damping means is required and there can be no difficulty with "hunting."

While the single time delay system is ideal from the standpoint of simplicity, it is usually not practical because of low gain and the power drain on the reference and measuring circuits. For instance assume a 2500-kw generator rated 600 volts and requiring 3 kw of excitation. For a gain of 50, the field voltage would be 12. Three kw at 12 volts is 250 amp. Since the reference bus must be at 600 volts, the drain from this source is 150 kw. An amplifier or regulating device is almost invariably required to get around such difficulties. Since all amplifiers have time delay, any practical regulating system has two or more time delays. They are a combination of regulator time delays, rotating machine field time delays, and mechanical time delays caused by the inertia of the system in motion.

Figure 3 shows a two delay system using a regulator operating in the field of a generator. The lower curve shows the generator voltage plotted against time for sudden application of full load at 0 time and assuming 10 per cent regulation. The curves are calculated on the basis of 0.1 sec and 1.0 second time delay in the rotating regulator and the generator respectively. The voltage immediately drops 10 per cent and then rises back to normal slowly or quickly in accordance with system gain. In this case, self-energization is used in order to provide high steady state gain, but it has practically no effect on transient response. The higher the gain, the quicker the response.

The top curve which shows rotating regulator voltage against time indicates the effect of different gains on ceiling voltage. This illustrates that regulating devices must have the proper ceiling voltages built into them to obtain the necessary response. For instance if the ceiling voltage of the regulating machine were 140



A	E_s	E_T NO LOAD	E_T FULL LOAD	% ERROR
0	–	100	90.00	10.00
1	200	100	95.00	5.00
2	150	100	96.67	3.33
5	120	100	98.33	1.67
10	110	100	99.08	0.92
25	104	100	99.62	0.38
50	102	100	99.80	0.20
100	101	100	99.91	0.09

Figure 2 — Simple regulating system illustrates the importance of system gain on steady state regulation.

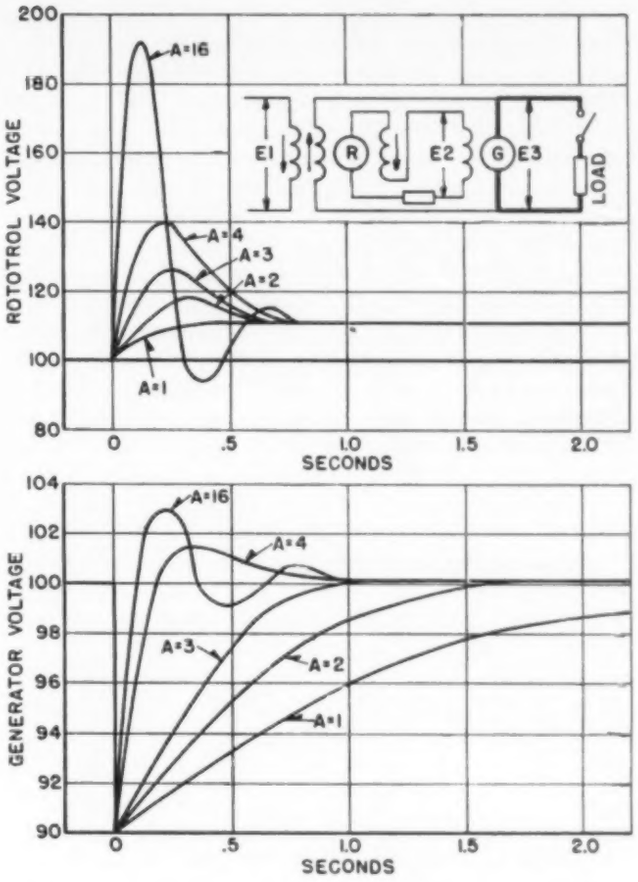


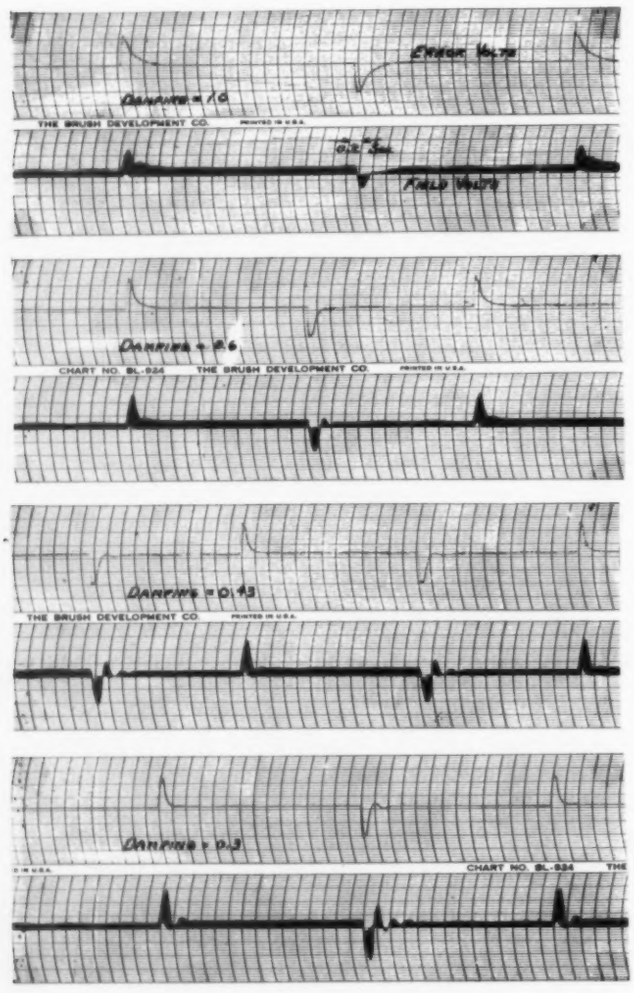
Figure 3 — Responses of a two-delay regulating system show the effects of gain on the transient response.

instead of 200, the fast response with a gain of 16 as shown on the lower curve, would not be possible.

For the higher gains of 4 and 16, the two delay system overshoots or has damped oscillations. While the single time delay is inherently stable, a system with two or more time delays may be oscillatory for high values of gain and for certain relations between time constants. This means that damping may be necessary in order to obtain the desired degree of stability.

Figure 4, which shows the performance of a two-stage, 60-cycle magnetic amplifier voltage regulator used with a 500-kw, 250-volt d-c generator, illustrates the effect of damping. The upper trace of each of these oscillograms shows error volts which is the difference between generator voltage and reference voltage. The lower trace shows the volts across the field of the 500-kw generator. These tests were taken by making an instantaneous change in reference voltage by inserting a resistor into the circuit. The effects of the different damping values show up in response time, different peak field voltages, and the response time of the regulator output from operating to peak voltage. All constants except damping were kept the same for this series of four tests. The total gain of the regulating system is 64. On the test at the top of the illustration which is highly overdamped the response is 0.6 of a second and the peak field voltage is approximately 75. For the second test with only 60 per cent of the damping, the system is still overdamped and the response is essentially 0.5 sec and the maximum field voltage is 110. The third film is essentially critically damped and the response is approximately 0.22 sec and the field voltage is 120 maximum. The last test is slightly underdamped and the response is 0.2 sec and the top field voltage is 125. Note that the rate of change of field voltage increases appreciably as the damping is reduced. With all damping removed the system oscillated violently.

Figure 4 — Response test of a two-stage magnetic amplifier voltage regulator illustrates the effect of damping.



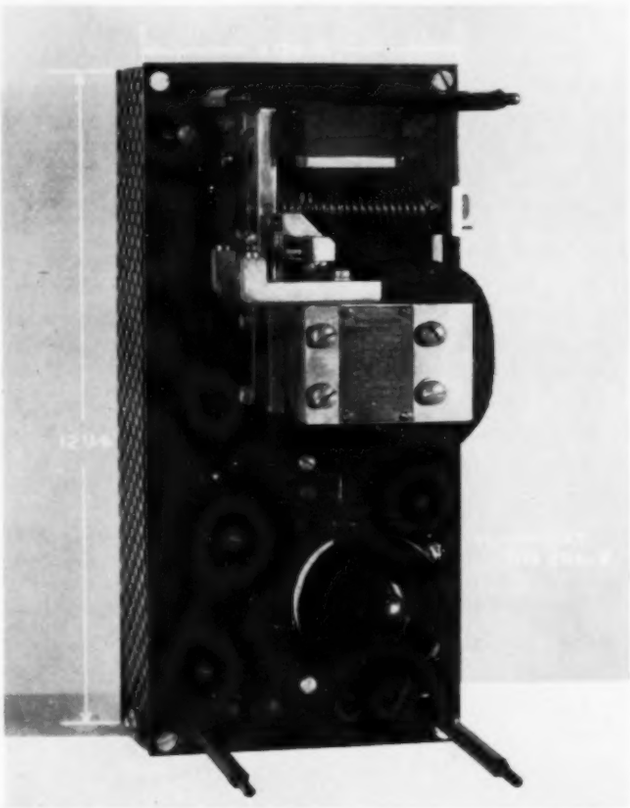


Figure 5 — View of rheostatic type of electro-mechanical regulator shows coil, spring, and rheostatic contact assembly.

The performance shown on these films is excellent as this is a high gain system with the regulator element designed for fast response and high ceiling voltage in order to force a quick change in the sluggish main generator field. The system for obtaining this performance will be shown under the discussion of "magamp" magnetic amplifier regulators.

With these fundamentals in mind let us consider operating experience and availability of the different types of regulators.

ELECTRO-MECHANICAL REGULATING EQUIPMENT

There are three types of electro-mechanical regulators used in mill applications today. These are the rheostatic, the balance beam, and the vibrating. Figure 5 is a view of the silverstat type of rheostatic regulator designed to regulate the voltage of an a-c generator. The coil measures the generator voltage and is balanced against the pull of the spring. Unbalance in these

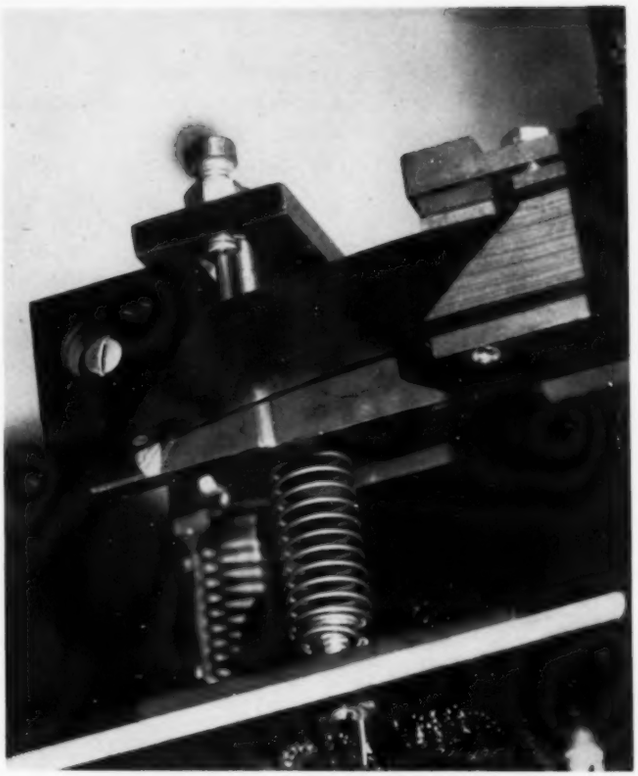


Figure 6 — Silver button contact assembly used in rheostatic type electro-mechanical regulator. Slight differences in the pull of the coil in the spring causes these buttons to make or break contact.

forces moves the armature which compresses or relieves the silver button contact assembly shown in Figure 6. These contacts are connected to a resistor in the field of the regulated equipment. Such regulators are small, are panel mounted, light in weight, require no external reference supply, and are relatively inexpensive. For this reason they have become the standard for voltage regulation of the smaller a-c generators, constant potential d-c generators and exciters and have been used extensively as ignitron rectifier voltage regulating elements and as a rheostatic element in tensiometer regulating systems.

The balanced beam electro-mechanical regulators have been supplanted almost entirely by the silverstat rheostatic type and the rotating regulators. However they are still used for arc furnace regulators as shown in Figure 7 where they do an acceptable job and have lower first cost than rotating regulators. They are also used as the voltage sensing element for large central station a-c generator applications and in some induction voltage regulator work. In this regulator, a beam is balanced on knife edges by the pull of a coil on one end and the pull of a spring or another coil on the other end. Slight changes in the regulated quantity upsets this balance to cause corrective action. In the figure shown, the regulator operates through the reversing contactors to control the electrode positioning motors.

The vibrating type of electro-mechanical regulator which used a set of rapidly vibrating contacts was, up until about 12 years ago, the workhorse of the regulator family in the steel industry. They were used for the regulation of tension on reel drives, and as voltage, speed, or torque regulators on a large number of mill and processing line drives. There are a large number still in operation on the older drives, but they have in general been supplanted by the rotating type regulator. They are still in use as sensitive relays but I know of only one that has been sold in the last five years for a regulating application in the steel industry. The reasons for this are that rotating regulators are much more flexible as regards application, require less maintenance, will reverse their output without special circuit arrangement, and can give smooth stepless control for practically any amount of power. Practically all of the electro-mechanical regulators are limited in the amount of power they can handle when compared to the rotating types. This is because they all depend on making and breaking electrical contact to effect regulation and for high gain and fast response these contacts must be relatively small.

ELECTRONIC REGULATORS

In general electronic regulators have not been applied in the steel industry where another type of regulator could do a satisfactory job. This is true because the operating man feels that electronic regulators are not as good as other types from the standpoint of simplicity, reliability, and maintenance. While some of this attitude has been based on the aura of mystery which surrounds electronics, most of it is based on practical operating experience with electronic tubes and components such as capacitors, resistors, sockets, etc. However, electronics have been applied in a considerable number of applications in the steel industry where it could do a better or cheaper job, where it has made possible a

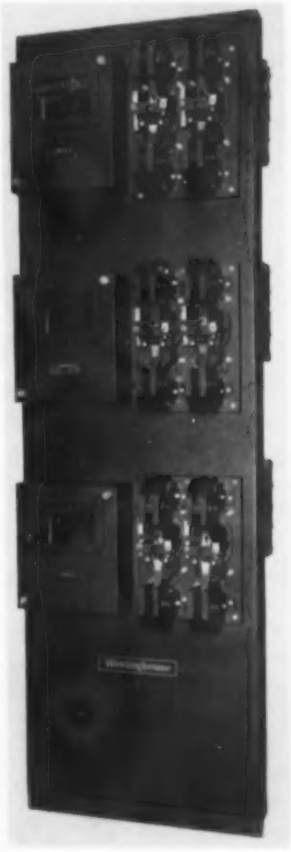


Figure 7 — Balance beam electro-mechanical regulator used for arc furnace power regulation.

system which cannot be done any other way, or where unusually precise or accurate control is required.

Because of the microscopically small amount of power required to control the grid of a vacuum tube, electronic circuits lend themselves easily to high gain operation and simplify the use of anticipating and damping means. Care, however, must be exercised in using very high gain electronic circuits, because pick-up of stray signals from nearby electrical apparatus, or high resistance grounds can cause a considerable amount of difficulty. Properly applied, electronics does an excellent job, and with intelligent maintenance procedures is a real production tool.

In the regulating field, electronics has been used in the steel industry mainly under two classifications:

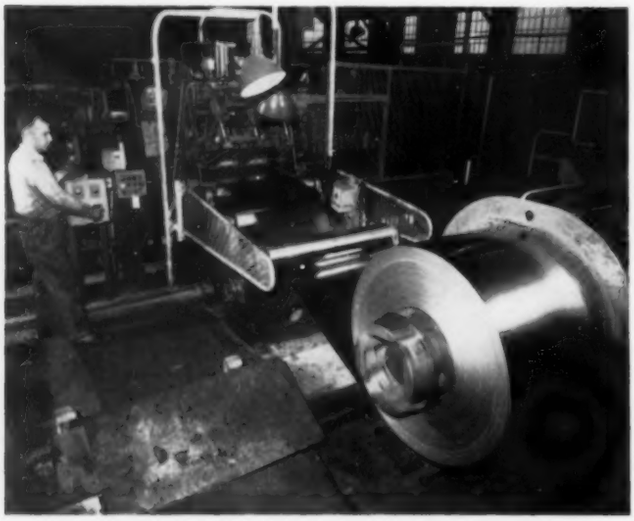


Figure 8 — This 3500-fpm side trimming line, utilizes a photo-electric edge position regulator.

1. Where the regulator has to "see" such as:
   a. Photoelectric loop regulators.
   b. Electronic pinhole detectors.
   c. Electronic edge control for slitting and cleaning lines.
   d. Control of the flow line on tin reflow application.
2. Where very precise and fast acting regulator components are required:
   a. Rod mill impact drop regulators.
   b. All electric flying shear regulators.

Figure 8 is a view of a high speed side trimming line utilizing a photoelectric edge position regulator. The device is located immediately after the pay-off reel and furnishes a signal to the electronic regulator which runs the hydraulic pump motor for the payoff reel shifting mechanism. This particular line operates consistently at 3500 fpm with excellent results. Figure 9 shows the electronic regulator and the small motor-generator set through which it acts to supply power to the pay-off reel shifting mechanism. This construction is typical of industrial type units of recent design which are easy to inspect and to service.

ROTATING REGULATORS

Rotating regulators because of their adaptability and flexibility for various applications, wide range of powers available, and ability to reverse output voltage without special circuit arrangement, cover a very broad field of application and are the present day workhorse of the regulator family. As an example, at the Fairless Plant of the U. S. Steel Co. we are supplying drives for a skin pass mill, a cleaning line, the finishing stands of the hot strip mill, the main drive and the auxiliaries for the 45-in. slabbing mill and the main drive for the 40-in. blooming mill. A total of 58 regulators are being supplied on these orders which are made up of 51 rotating regulators, three magnetic amplifiers, three silverstat electro-mechanical regulators, and one electronic regulator. This distribution is typical of present day practice on any large installation. It indicates the wide acceptance and usage of rotating regulators which has been engendered by successful operating records.

Rotating regulators are easily adaptable to systems having moderate to high gain requirements, the transient response is sufficiently fast, and stability requirements have been met without undue difficulty.

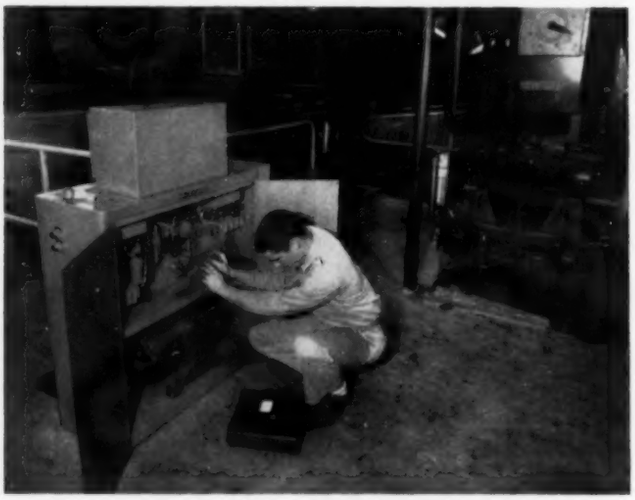


Figure 9 — Electronic regulator to regulate edge position is typical of the construction of recent industrial regulators.

The main and auxiliary drives of the blooming mill are good examples of applications requiring a large number of rotating regulators and one in which operating experience has been uniformly good. On the main drive of a blooming mill, rotating regulators are used to regulate and reverse the generator voltage, force fast response of the large motor fields, limit the main armature currents to predetermined values, and for load balance control where two or more armatures are operated in parallel. Figure 10 shows a view of an 8000-hp, 40/80-rpm, twin drive for a blooming mill which utilizes five rotating regulators for the above functions. It has been found that in general the rotating regulator is able to reverse the main generator voltage faster than most operators prefer. On the installation pictured the time of reversal from base speed to base speed is over two seconds and when we attempted to improve this time through adjustment of the system, the user would not allow it. On two other installations which have gone into service recently, one to control a 7000-hp, single armature drive, and the other to control an 8000-hp twin drive, the regulating system was initially adjusted for a 1½ second reversal from base speed to base speed.

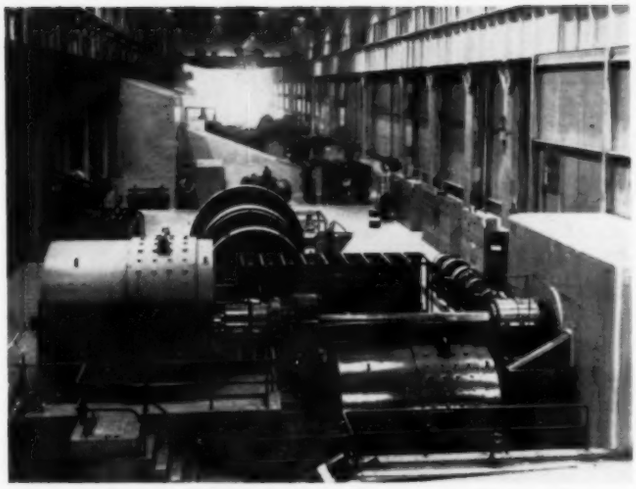


Figure 10 — This 8000-hp, 40/80-rpm, twin-drive for a blooming mill utilizes five rotating regulators for fast response and load balance functions.

In both cases the customer after short operation, requested an increase in reversal time since they felt a two second reversal was sufficiently fast and would result in less maintenance on the mechanical equipment. Figure 11 shows the reversal of voltage and speed on a 10,000-hp twin drive now being installed in the Pittsburgh district. The time for complete reversal is about one second which is unusually fast for a heavy mill. The mill expects to start operations with considerably slower reversal time.

This experience contrasts sharply with other opinion which believes that the faster the reversal the better.

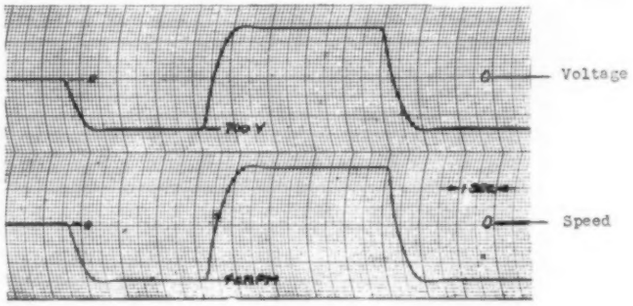


Figure 11 — Reversal of speed and voltage from base speed to base speed on a 10,000-hp, 40-rpm twin-drive for a slabbing mill.

Actually on heavy mills, where the ingot or slab is entered in the rolls at low speed and the mill accelerated, fast reversal accomplishes nothing because the heavy rolling torques, plus accelerating torques brings the drive under current limit operation. However, there is a definite trend toward faster reversals, and it would be interesting to hear the opinions of the operating people on this subject.

The possibility of easy adjustment of the rotating regulator system to meet a wide range of reversing mill operating requirements is a good indication of its flexibility.

There are numerous auxiliaries about the reversing blooming mill which require variable voltage drives under control of rotating regulators. Figure 12 shows a typical installation where variable voltage is used for the feed rolls, the tables, screwdowns, manipulators, and the bloom shear. In this instance, two auxiliary sets are used so that in the event of loss of one set, the motor armatures can be operated in parallel on the single generator of the other set. Figure 13 shows these variable voltage sets in the motor room with the rotating regulator sets in the foreground and the control panels in the background. Figure 14 shows schematically the arrangement of rotating voltage regulator with current limit control used on such drives. Neglecting the current limit field, the rotating regulator is a voltage regulator which adjusts the generator voltage as called for by the pattern field. If the armature current exceeds a certain value — either motoring or regenerative — current

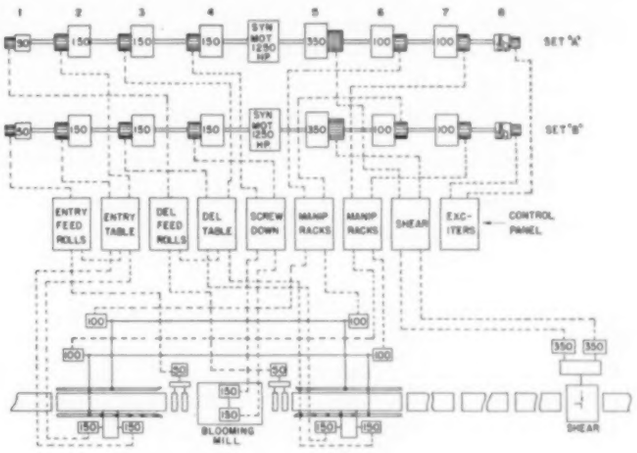


Figure 12 — Block diagram of variable voltage auxiliary drive arrangement for a large blooming mill. The scheme uses two motor-generator sets for maximum flexibility under emergency conditions.

flows in field CLF in such a direction as to give the generator characteristics shown in the upper right hand curve. Rectifier B is a blocking rectifier to assure proper direction of current at all times. Resistor R2 is a leaking resistor designed to give the necessary droop up to the current limit setting. Rotating regulators give much faster response than the three field generators previously used, and the desired characteristics are obtained with moderate values of gain. The rotating regulator is designed to force the generator voltage to respond fast

Figure 13 — These motor-generator sets and variable voltage control have the arrangement shown in Figure 12.

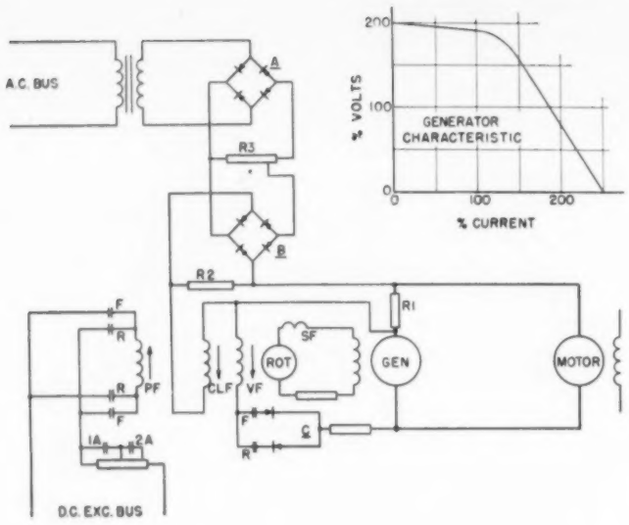


Figure 14 — Schematic diagram of rotating regulator control for reversing mill auxiliary drives.

enough so that any of the drives will come into current limit operation. For a drive soon to be installed, the values of acceleration time from zero to maximum speed, without exceeding an average of 200 per cent of motor capacity and taking into consideration friction loads are estimated to be as follows:

	Acc time	Decel time	Motor arrangement
Mill tables	1.4	1.0	2 x 200-hp, 230 v
Manipulators	1.1	0.7	2 x 200-hp, 230 v
Screwdowns	3.0	1.0	2 x 200-hp, 460 v
Feed rolls	1.4	1.0	2 x 17-hp, 40 v

These values are well within the response times which can be obtained with the regulator system shown.

MAGNETIC AMPLIFIER REGULATING SYSTEMS

The magnetic amplifier, a device which has no moving parts, shows promise of being applied in considerable numbers in the steel industry as a regulating device. The device is not new but has been known for years. The first applications were simple saturable core reactors in which the impedance of the reactor was changed by saturating the core with a direct current control winding. The saturable reactor was used mainly as a control device and not as an automatic closed cycle regulating element. Recent developments in self saturating circuits, in which the load current aids in saturating the core, have increased the amplification obtainable and made possible the use of the device in sensitive automatic closed cycle regulating circuits. These developments consist of improvements in core materials and rectifiers and a better understanding of self-saturating phenomena.

Figure 15 is a schematic diagram of the magnetic amplifier applied to regulate the voltage of a direct current generator. The output of the power winding is rectified and applied to the generator shunt field and the unidirectional current which flows helps to self saturate the cores indicated by the shaded rectangles. The d-c generator voltage is bucked against a reference voltage through the control winding of the magnetic amplifier. The curve of control ampere turns against output amperes shown on the bottom of this illustration shows how the output of the magamp varies with ampere turns in the control field. Actually a very small change in control ampere turns will cause a correspondingly large output so that accurate voltage regulation is obtained. Two cores are always used to minimize the voltage induced in the control windings and to obtain better speed of response.

Figure 16 shows the transfer curves — direct current control amperes plotted against load amperes — obtained with magnetic amplifiers. The upper curve shows the transfer characteristics of a single magnetic amplifier such as shown in Figure 15. The transfer curve can be shifted by adding a bias winding excited from a constant potential d-c source. The lower curve shows two magnetic amplifiers designed for reversing operation. The forward and reverse magamps are biased so that the resultant output is zero with zero direct current control amperes. Operation results in the combined transfer curve which is very similar to the saturation curve of the rotating regulator.

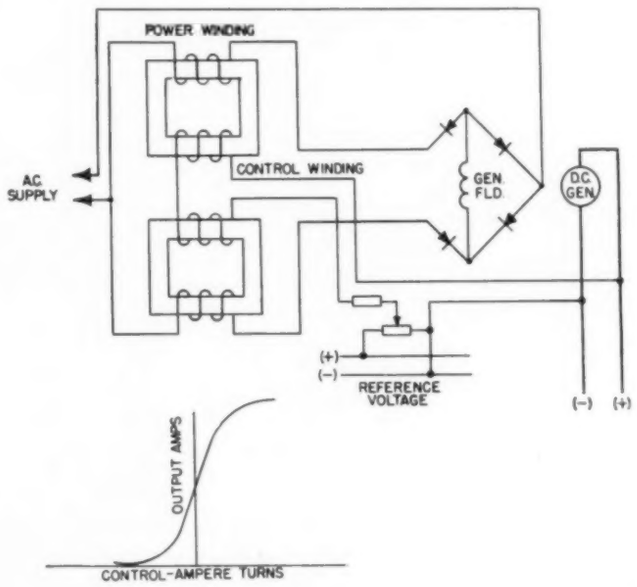
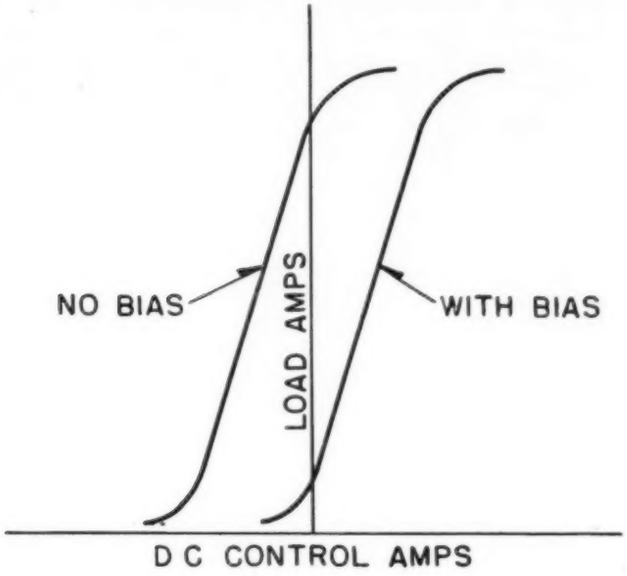


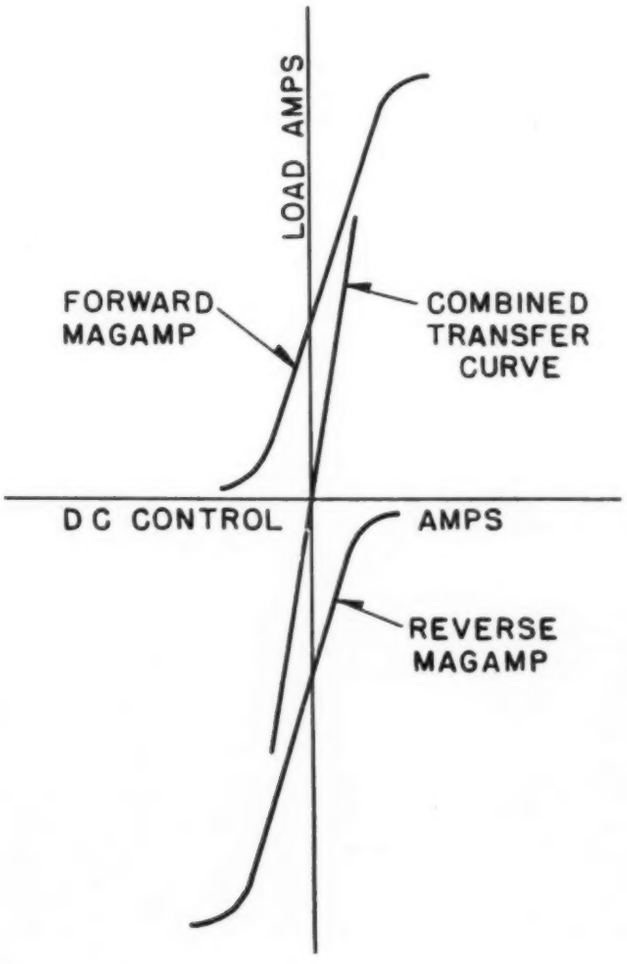
Figure 15 — Schematic diagram of a simple magnetic amplifier regulator arranged to control the voltage of a d-c generator.

The magnetic amplifier is a single stage amplifier and often two stages are used to achieve the degree of amplification required. Figure 17 is a block diagram of a two-stage magnetic amplifier applied as a stand control for one stand of an individual generator tandem cold reduction mill drive. The scheme uses three magnetic amplifiers. The control and the power magamps are operated in cascade to perform regulating functions and furnish power to the main generator field. A separate magamp is used for IR drop compensation. This development was made as part of a standard development program with a view towards equalling or bettering if possible

the excellent performance obtained from rotating regulator systems now in use. This system was built and tested on full scale equipment at the East Pittsburgh

Figure 16 — Transfer curves of magnetic amplifiers. The top chart shows the curves for a unidirectional unit with and without bias. The bottom curve shows individual and combined transfer curves for back-to-back magnetic amplifiers for reversing operation.





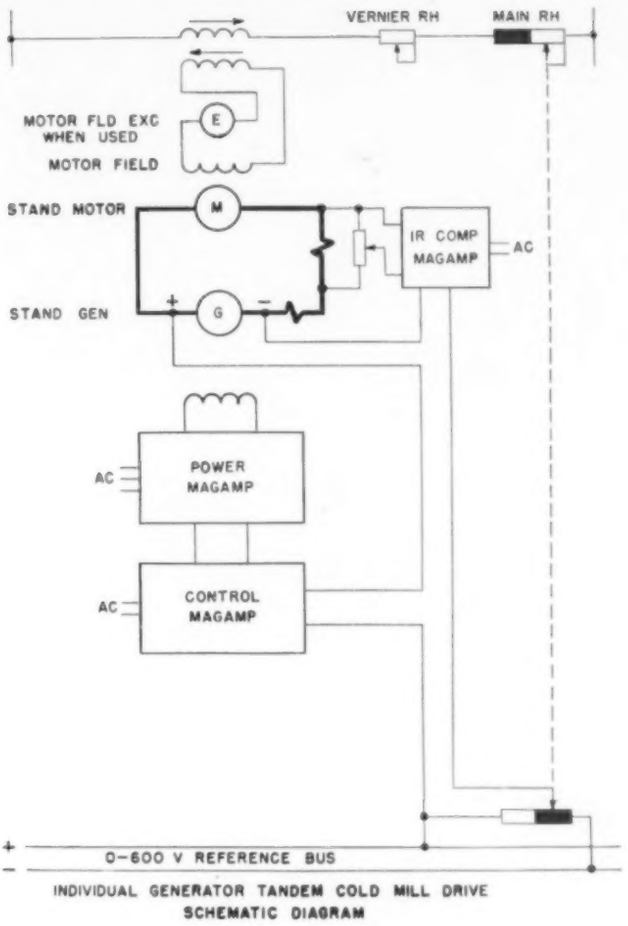
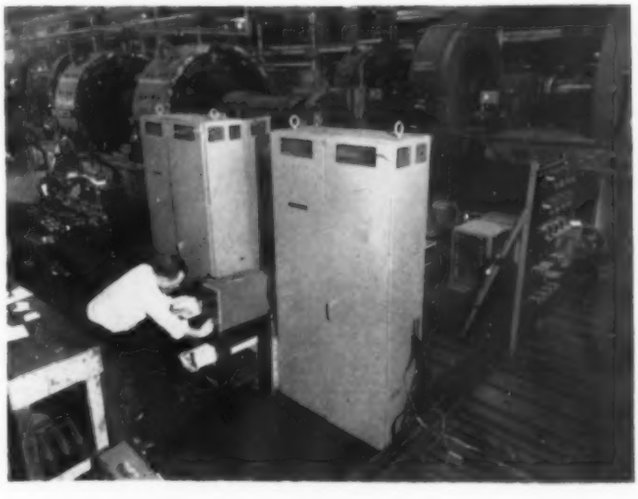


Figure 17 — Block diagram shows a magnetic amplifier regulating system being built for the control of a four-stand tandem cold reduction mill.

Works. Figure 18 shows the test set-up which utilized the equipment for the No. 4 stand drive being built for a 66-in. four-stand tandem cold reduction mill. The generator is rated 3600 kw at 360 rpm and the motor is a 4000-hp, 200/485 rpm double armature unit. The

Figure 18 — Test set-up of magnetic amplifier regulating system for tandem cold reduction mills using a 4000-hp double armature motor with its individual 3600-kw generator.



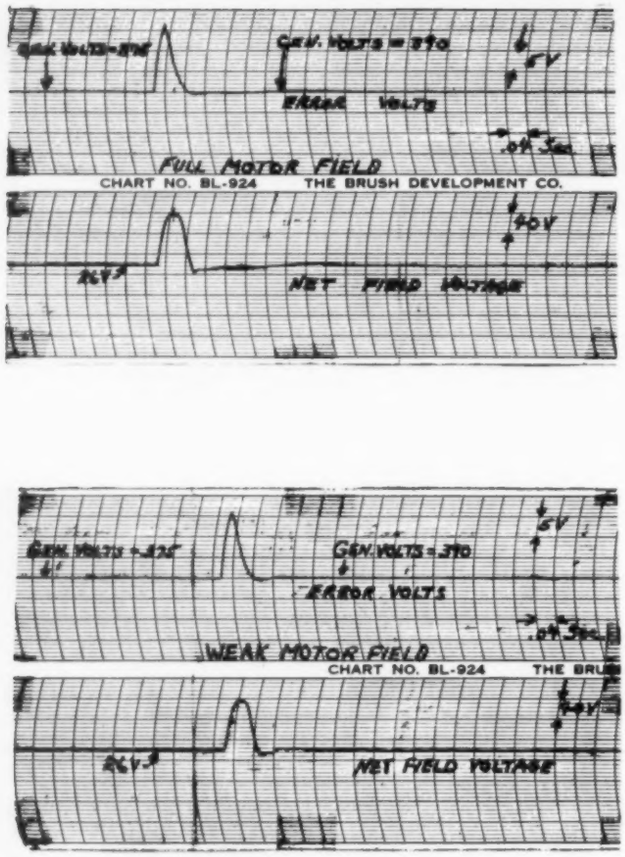


Figure 19 — Response tests of a 400 cycle magnetic amplifier regulator for tandem cold reduction mill. The oscillograms indicate the high forcing field voltages necessary to obtain an unusually fast response of less than 1/10 of a second.

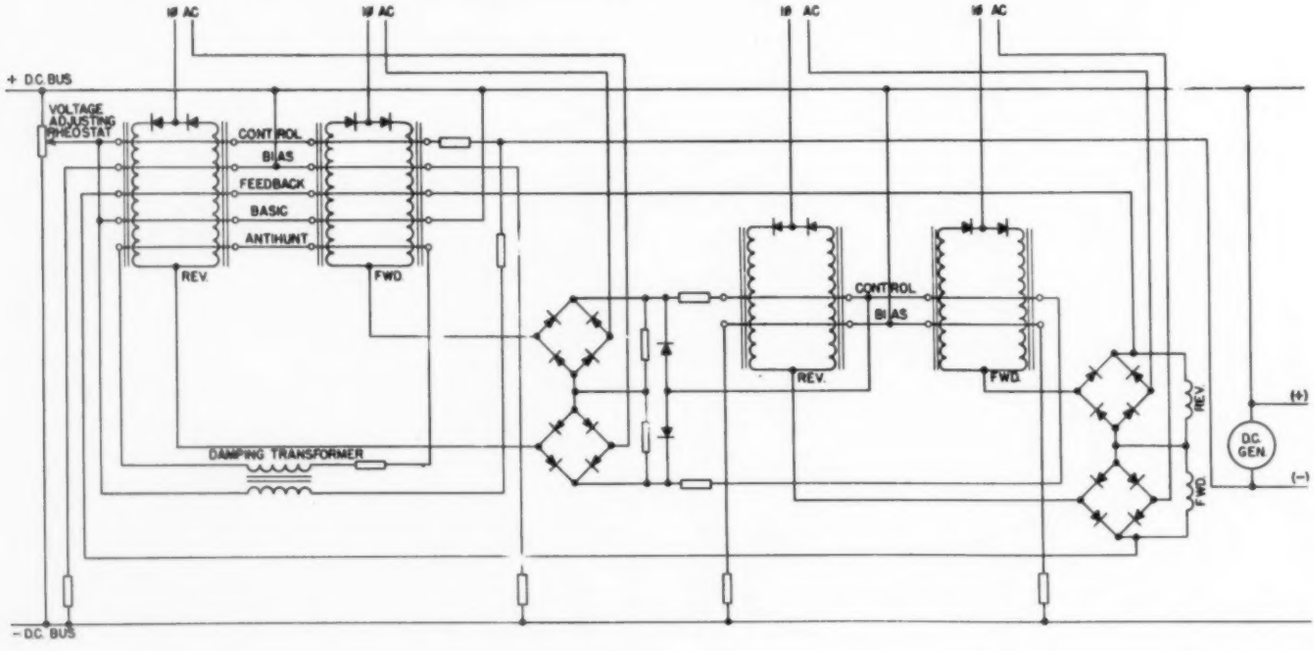
cabinets in the foreground house a 60-cycle and a 400-cycle magnetic amplifier. Since the response of a magamp is inversely proportional to the supply frequency both a 400-cycle and a 60-cycle magnetic amplifier were tested.

Figure 19 shows response curves and output magamp voltage curves taken by inserting an instantaneous voltage into the reference bus by suddenly switching a battery into the circuit. This test is more stringent than any mill operating condition, but serves as an excellent measure of control system performance. It will be noted that the response as indicated by the error voltage trace is less than 0.1 sec with practically no overshoot which indicates an exceptionally stable system. The exciter voltage trace shows that the power magamp voltage rises to over 450 per cent of normal value in less than 0.05 sec, whereas the generator shunt field time constant is approximately 4 sec. These tremendous forcing voltages are responsible for the very fast response of the system. The performance is amazing when it is considered that in less than 0.1 sec the generator field voltage rises to many times its rated value to force the correction and then returns to normal to prevent any overshoot.

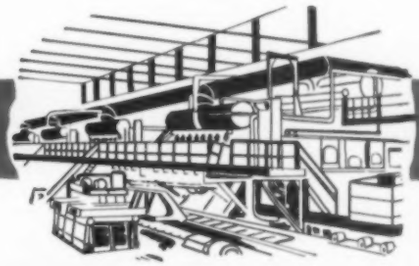
The next illustration, Figure 20, shows the schematic diagram of a 60-cycle, two-stage magnetic amplifier voltage regulator applied to a 500-kw, 250-v d-c generator. This is the high-gain two-stage system designed to give fast response and good damping, and is the system on which the response curves shown earlier in Figure 4 were taken. In order to get both forward and reverse operation of the generator voltage, a forward and a reverse magamp system is used.

The voltage of the d-c generator is bucked against the bus voltage and the difference is applied to the control field which is shown as a straight line for simplicity in reading the control circuits. The output windings are as shown by the wavy lines. The sum of the voltages from the first stage is rectified and applied to the control field winding of the second stage magamp. The output of the second stage is directly applied to forward and reverse direct current generator fields.

Figure 20 — Schematic diagram shows the detailed components of a two-stage, 60-cycle magnetic amplifier voltage regulator. Response curves for this system are shown in Figure 4.



Ask the men who operate them



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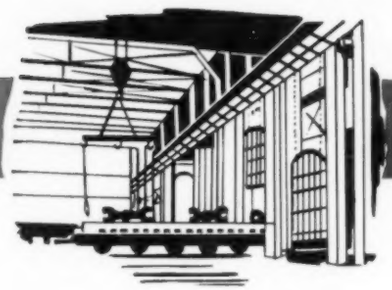

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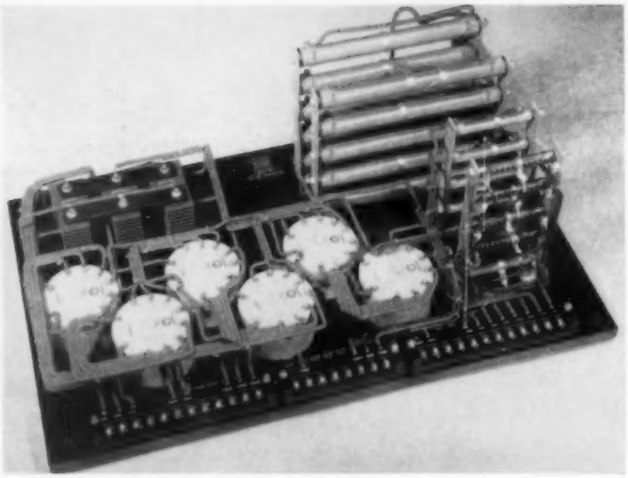

Figure 21 — View of a 60-cycle magnetic amplifier voltage regulator for control of an 8000-kw ignitron rectifier for hot strip mill service.

Several additional windings are used on the first stage magamp as follows: The bias winding is merely to serve to obtain the proper operating point on the forward and reverse transfer curve so that zero output is obtained with zero control ampere turns. The feed back winding is negative and is connected across the output of the second stage amplifiers. By using high gain initially and degenerative feed back, the circuits are made more linear and the response improved at the same time. The basic excitation field is connected across the voltage adjusting rheostat. With this field alone the magamps would adjust the generator voltage to approximately its correct value. Therefore the control field need only to supply the small differences. Such a field is primarily used where two or more systems must be very closely matched such as in the tandem cold mill regulating system. A separate anti-hunt field is used in the secondary of the damping transformer, and adjustments in resistance in the damping transformer circuit gave the changes in damping shown on the response illustration (Figure 4).

We are at present building a 400-cycle magnetic amplifier system for use on a 66-in. four-stand tandem cold reduction mill with a maximum operating speed of 3100 fpm. This mill is designed primarily to roll sheet products. It will be installed in the Pittsburgh district.

The general run of applications will use 60-cycle magnetic amplifiers since, as shown by the curves, fast and well damped performance can be obtained and 60 cycles is normally available. Figure 21 is a view of a 60-cycle, "magamp" panel which regulates the voltage of an 8000-kw ignitron rectifier for hot strip mill service.

The primary advantages of the magamp compared with other types of regulating equipment are as follows:

1. Requires no periodic maintenance — there are no tubes to replace and no bearings, brushes, or commutators.
2. Units can be panel mounted and wired, and installation expense will be reduced.

In addition to the tandem mill regulator we are making the following magamp applications:

1. Reel drives for cold reduction mills.
2. Speed regulation for high speed side trimming line tension reel.
3. Speed regulation for the bridle rolls on cleaning lines.
4. Tension reel drives for processing lines.
5. Tensiometer type tension regulators for skin pass mill.
6. Voltage regulator for ignitron rectifiers.

Operating experience with magnetic amplifiers is somewhat limited since the device has been applied only recently. The bulk of operating experience to date has been in military applications where the device is used to supplement or replace electronic tubes. Operating experience with existing installations has been good and the performance of the systems scheduled to go into operation during the next year will be watched closely. We are following the practice of laboratory testing of all new systems using the device in order that there be a minimum of field adjustments. Because of its inherent advantages it is believed that the magnetic amplifier will find a fairly wide field of application in the steel industry. It will not supplant rotating regulators but it is another useful tool for the control man's kit.

This paper has discussed the pertinent factors involved in regulating systems.

DONORA WORKS INSTALLS GAS WASHING UNIT

▲ A new gas washing installation was placed into operation on September 18 at Donora Works. This will remove practically all of the iron ore dust from the blast furnace gases at this plant. This new equipment represents the most modern installation of its kind in the country and incorporates some of the most recent attempts in industry's attempts to combat air pollution. It recovers four times as much flue dust as the former facilities.

The old gas washing equipment at this plant was inadequate under U. S. Steel's program to cooperate in the general smoke prevention movement in Western Pennsylvania. The new washer performs a dual purpose, by helping provide a cleaner atmosphere in Donora and also helps to recover a large amount of steelmaking raw material. The new operation will convert Donora's waste blast furnace flue dust to re-usable raw materials.

Water sprays of the big unit will use more than nine million gallons of Monongahela River water daily. After it circulates through the system, the water will be returned to the river as clean as, or at times cleaner, than when it was taken out. About 120,000 cu ft of gas from the Donora blast furnaces will go through the mammoth new washing tower. Washed virtually free of dust, the gas will be used to fuel the boilers and also the blast furnace stoves. The captured dust will be pumped to a settling tank to be collected as a watery sludge. The water in this soupy liquid, in turn, will then be drawn by vacuum through disc-shaped canvas filters, leaving the dust caked into usable form for sintering.

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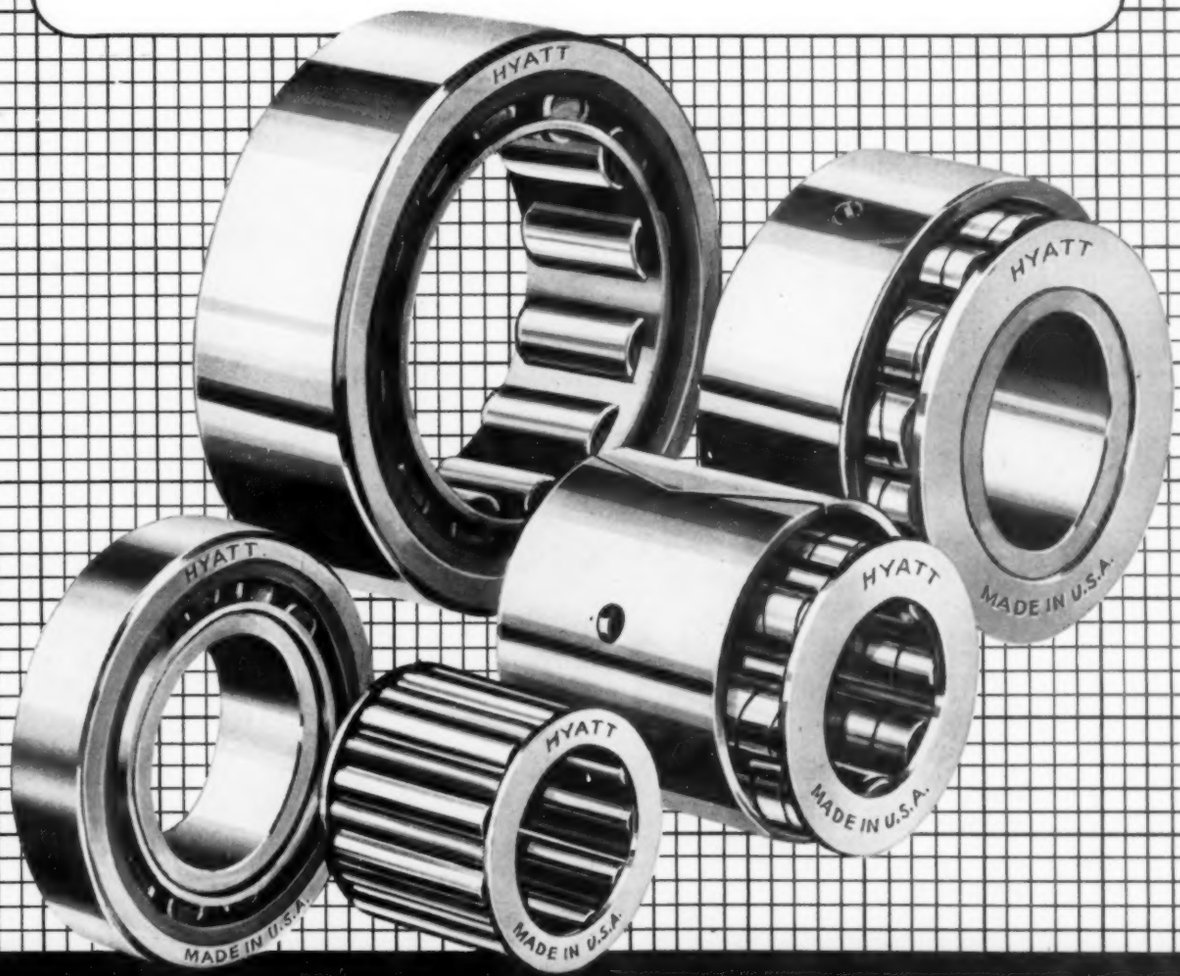


HYATT ROLLER BEARINGS

FLOATING HAMMER FORGES 15,000TH INGOT

▲ A new, steam-operated hammer that literally floats on a concrete raft in a concrete basin has just forged its 15,000th ingot at the Huntington Works of The International Nickel Co., making a total production for the hammer of 75,000,000 pounds, it was announced on Sept. 11.

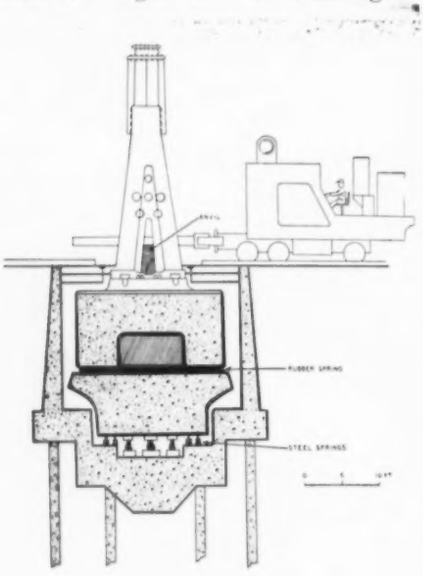


Figure 1 — Simplified drawing of the new, 8-ton hammer and foundation at Inco's Huntington Works.

Details of the design and construction of the mounting are so new that they have been previously withheld until the development had proved its value in service.

Much of the production to date has been forgings of the high nickel alloys used for jet engine parts and other heat-resistant applications. The strength and toughness of these materials are such that they pose special forging problems not common in the production of the more widely used industrial metals such as steel, or the softer materials such as most of the copper-base alloys.

With an over-all weight of 521 tons, this modern prototype of the old-time village smithy — about three stories high — converts huge nickel alloy ingots from the melt shop into workable forms for further processing as sheet, strip, rod, wire, tubing, and other commercial forms. An elaborate arrangement of springs eliminates ground vibration which reduces maintenance costs throughout the plant as well as in the forge shop.

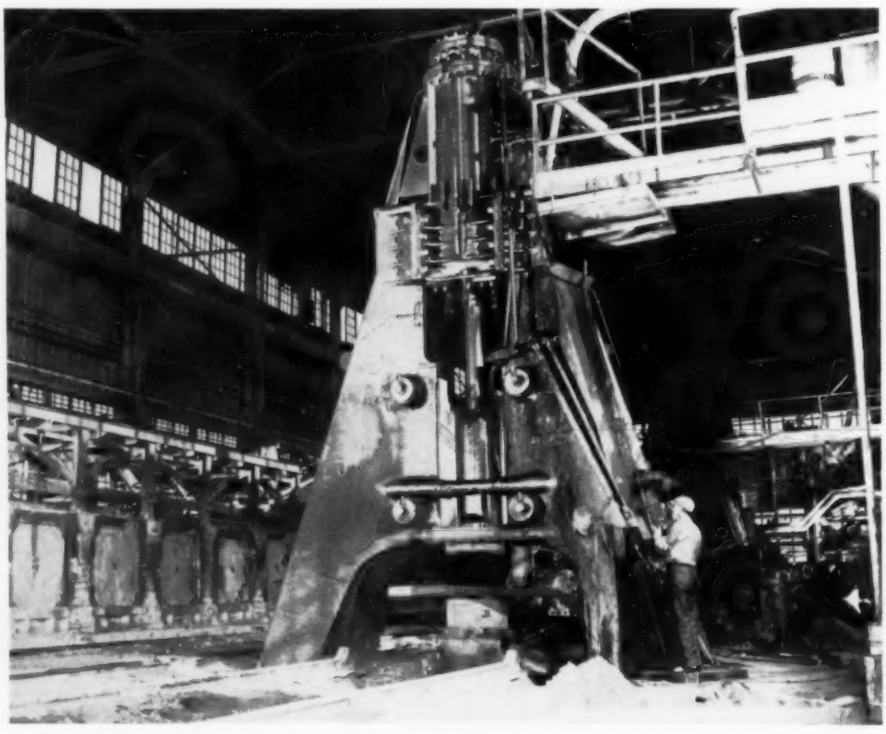
The Huntington installation marks the first time this novel type of foundation has been used for a steam-forging hammer. It represents a joint development by vibration and other technical experts in this country and abroad, as well as by the engineering staff of the Huntington Works.

Legs and anvil of the hammer are bolted to a concrete base 21 ft long, 18 ft wide, and 10 ft thick. This base rides on a unique type of rubber spring, or cushion, supported by a second block of concrete of similar size. Both concrete blocks from the "raft." The rubber spring is a slab of special-type rubber, bonded on each side to a steel plate. The bottom of the second, or lower, concrete block in turn rides on 432 steel coil springs, somewhat resembling those used on railroad cars.

The steel springs are mounted on a concrete floor supported by cement piles, or pillars. Altogether, the foundation from the top of the uppermost concrete block to the bottom of the pillars reaches 40 ft below the floor of the forge shop.

This construction differs radically from the conventional steam hammer foundation which hitherto has consisted of concrete pad and several tiers of lumber 12 inches square. Vibration from the old-type foundation could be felt throughout the 90-acre plant. Its effect was marked on other equipment in the hammer shop as well as in all other adjacent buildings, including the machine shop and extrusion building, and added considerably to maintenance problems. The foundation represents a joint development by J. H. A. Crockett, London, England, the designer; Robert W. Hunt Co., New York City, who had technical supervision of the construction; the engineering staff of the Huntington Works; and various technical consultants in this country and abroad.

Figure 2 — Steam operated unit has 8-ton ram.



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A Rotary Coil Pickling Plant

▲ A greatly simplified, low-cost pickling plant operating on an entirely new principle, has been designed for handling anywhere from 5000 to 18,000 tons per year of commercial grades of coiled hot rolled strip, in widths from 2 to 14 in. and in gages from 0.042 to 0.188 in.

Low first cost of the equipment, in addition to low labor and operating cost, enable users of coiled strip to do their own pickling and oiling economically, in the sizes, gages, and tonnages indicated. In fact, the processing cost is only a small fraction of the premium commanded in the open market for these services.

The equipment was developed in Great Britain where several plants, such as described in the following, are in successful operation. Sole manufacturing rights for North America have been acquired by The Yoder Co. of Cleveland, Ohio. This company is now prepared to offer plants of improved design, with capacities for handling material such as indicated, in widths up to 24 in., with correspondingly higher tonnage production than just mentioned.

Distinctly new and basic features, never before offered in pickling plant equipment, are illustrated in the drawing of Figure 1 of the methods of operation, with coils loaded into cages and rotated at about 20 rpm in a pickling tank.

The separate tasks of uncoiling scale breaking, loose coiling and pinning, heretofore essential steps in coil pickling operations, are all performed with a minimum of hand labor, by the almost automatic operation of the cages loaded with coils. Figure 1 (top left) shows a coil about to be unloaded into a cage. The top right shows the coil half way uncoiled by the simple device of revolving the cage in direction opposite to that of the coil windings.

This rotation of the cage tends to carry the coil around with it, but is resisted by the weight of the coil, so that it remains near the bottom of the cage while its leading end is being carried around with the cage. This causes the strip to be unwound, wrap by wrap, rearranging itself against the rim of the cage. The lower left sketch of Figure 1 shows the approximate shape of the coil at the end of unwinding. At this stage the direction of rotation is reversed, which causes the coil to be rewound. The lower right shows the coil about halfway rewound. At its completion, the coil is restored very closely to its original diameter and tightness of winding. This completes the operating cycle, which is then repeated once, or sev-

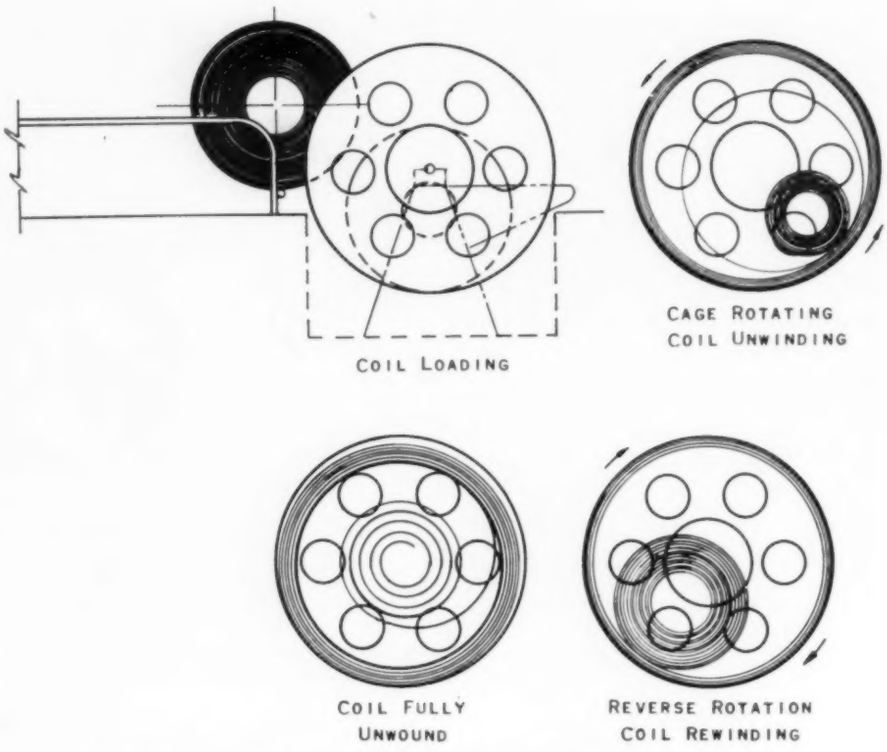
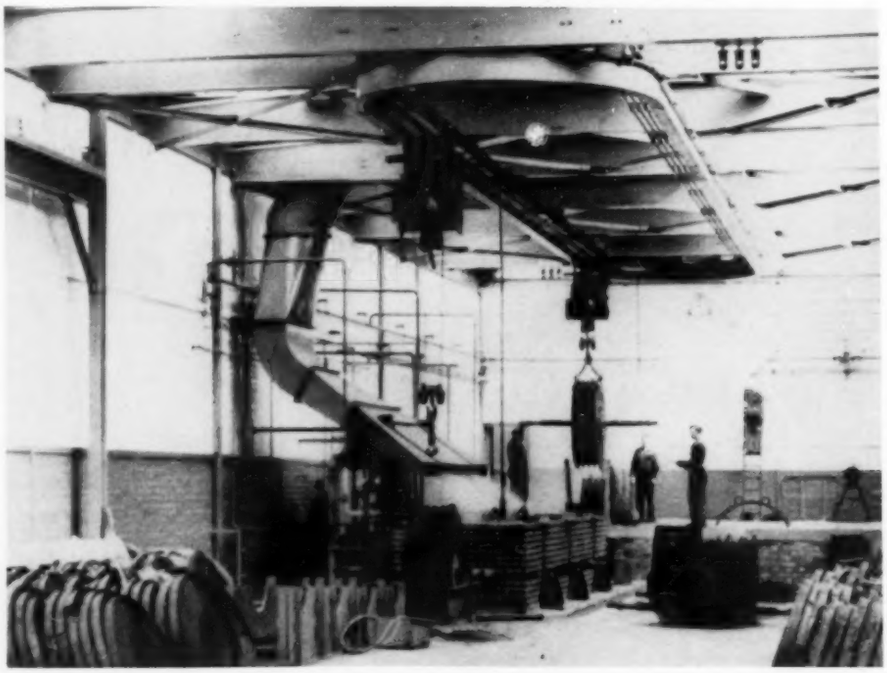


Figure 1 — Sketch shows method of unwinding and winding coils.

Figure 2 — Unit in operation shows small space required.



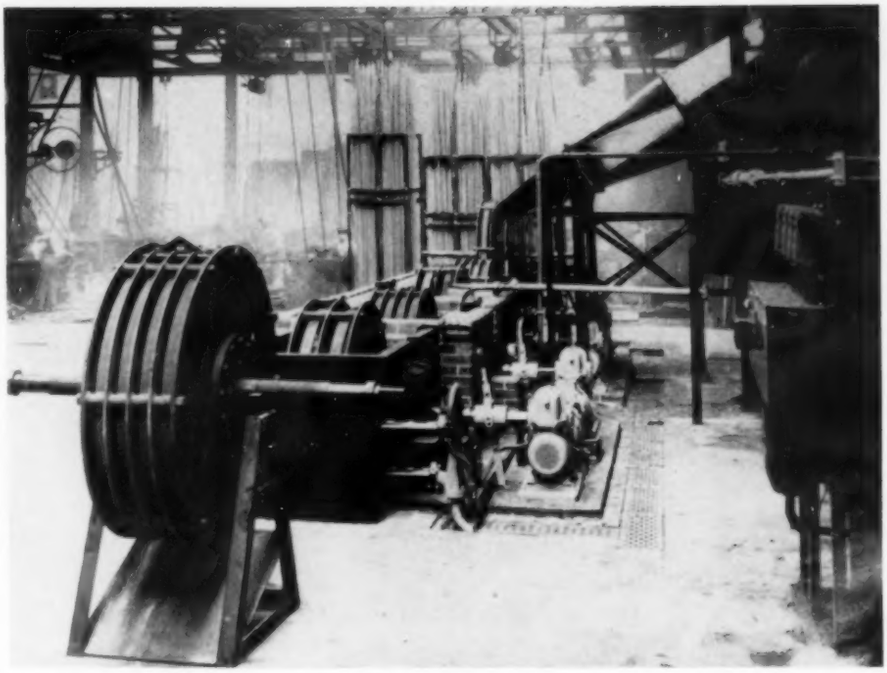


Figure 3 — Close-up of coil bearing cages and tanks in rotary coil pickling and oiling plant shows each tank equipped with individual 5-hp motor, gear reducer and clutch for rotating the cages in both directions. Cages are partitioned for placement of two or more coils side by side.

eral times, depending on the strength and purity of the acid solution.

By the repeated flexing of the stock in unwinding and rewinding the coil, the scale is being loosened, facilitating its complete removal by the acid. At the same time, the violent agitation of the liquid, resulting from revolving the cage in it, increases the efficiency of the acid in dissolving, loosening and removing the scale. Thus the pickling is completed in 15 to 30 minutes, depending on the strength of the acid. Each coil is then transferred to the adjoining rinse water tank where the cage is again rotated, and the coil again unwound. The cage carrying the unwound or expanded coil now goes to the oil bath for rotation in opposite direction and rewinding to its original size, ready for use.

With a cage load of about 2500 lb, for strip of 14-in. width, an average production of three tons per hour may be maintained. This estimate presupposes a change of acid once in 8 hours. With wider cages, higher production will be obtained.

Figure 2 shows a plant now in operation. It shows the exterior of the acid and rinse tanks covered with brick, and the acid fumes being removed by a high velocity overhead exhaust system. The tanks are built deep enough to prevent splashing over their edges. The drive is by individual 5-hp motors, gear reducers and heavy clutches connecting the reducer drive shafts to the respective trunnion shafts of the cages. These features are illustrated in Figure 3, a close-up of the plant from the opposite end, showing the oil tank in the foreground, loaded cages being seen projecting slightly above the edges of the different tanks. Some of these cages have one central partition, being intended for holding two coils side by side, and others have three partitions, designed for holding four coils.

Provision is also made for maintaining the temperature of the acid solution between 165 and 185 F, as well as for emptying and refilling the tanks, neutralizing and disposing of the waste liquids, etc.

The relatively low cost of the equipment, its tonnage capacity and high efficiency, make it particularly suitable for strip cold reducing mills; also for metal working plants, in general whose annual requirements in hot rolled coiled strip are considerable. Most important among these are manufacturers of automotive equipment, household appliances and building components, who operate power presses, cold roll forming machines, resistance weld tube mills, etc. Such manufacturers will now be able profitably to do their own pickling of hot rolled stock in preparation for forming, welding, assembly, and finishing.

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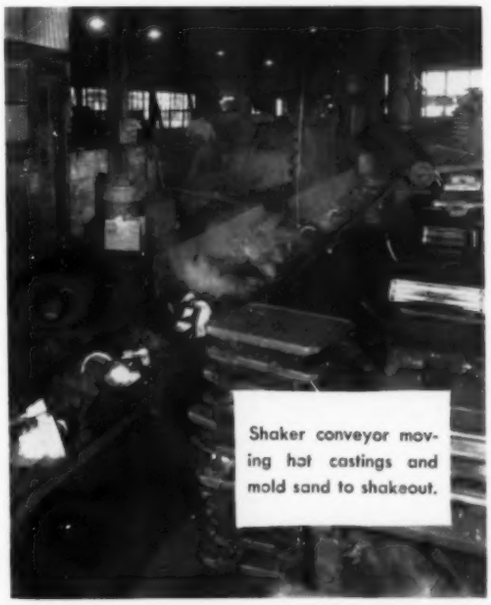

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2. **They stand up under severe operating conditions, where heat and abrasion make the use of belt and chain conveyors costly or impractical.**
3. **Small tonnages or large tonnages are easily moved for short or long distances — on the level, upgrade, or downgrade.**
4. **Maintenance cost is low, continuity of operation is high.**

Every Goodman Shaker Conveyor installation is specially engineered to suit job conditions.

GOODMAN MANUFACTURING COMPANY

Industrial Manufacturing Division

Halsted Street at 48th **Chicago 9, Illinois**

Pictorial Review . . .

1952 ANNUAL AISE CONVENTION AND IRON AND STEEL EXPOSITION

All previous records for attendance, exhibitors and exhibit space were shattered by the 1952 Annual Convention and Iron and Steel Exposition of the Association of Iron and Steel Engineers. Cleveland's vast Public Auditorium housed the exposition and technical meetings, while the social functions were held in the Hotel Statler. Registration (1) from September 30 through October 3 totaled 14,795. Exhibits occupied 42,355 sq ft in three halls of the Auditorium (Arena Hall (2), Exhibit Hall (3), and North Hall) and featured the products of 190 manufacturers using 411 booths. Technical meetings were held in Club Room B and the Ball Room (4) and included 39 technical papers covering all phases of steel mill operation, engineering and maintenance.

Ladies were entertained with luncheons and style shows arranged under the guidance (5) of ladies from the Cleveland district section.

The annual banquet (6) was attended by 1125 persons and necessitated the use of both the Euclid Room and the Ball Room at the Hotel Statler.

I. N. Tull, president for the current year, presided at the 1952 AISE Convention. He is shown in (7) with John L. Young, AISE president-elect for 1953, and James Farrington, founder of the Association.

During the convention, it was announced that Louis Moses won the coveted AISE John F. Kelly Award for the best AISE paper presented during 1951. He is shown (8) with F. H. Wickline, second place award winner, and John R. Chegwidden, winner of third place award.

Old Timers held their annual get-together in the Hotel Statler. Shown in (9) are T. J. Ess, W. Trinks, and Leonard Larson.

Participants in the technical sessions gathered each morning at 7:45 a.m. for the authors' and chairmen breakfast. The following groups were among those meeting each morning: Electrical session (10) — (standing) A. J. F. MacQueen, F. C. Reutenauer, (seated) A. S. Morrow, W. J. Tunny, and H. S. Fegely, Combustion session (11) — (standing) M. N. Ornitz, F. S. Swaney, F. P. Hubbell, (seated) R. A. Lambert, E. T. W. Bailey, and R. H. English, Mechanical session (12) — J. B. Whitlock, J. B. Allen, J. E. Anderson, J. A. Bell, J. D. Tulloch, D. E. Knight, and F. E. Robinson, Electrical session (13) — (standing) Dr. W. A. Thomas, E. L. Anderson, W. E. Miller, (seated) L. D. Cook, and F. H. Wickline, Blast Furnace session (14) — C. G. Hogberg, W. H. Collison, Carleton Lord, J. E. Brassert, and R. P. Bremner, Lubrication session (15) R. C. Williams, R. A. Kraus, N. I. Whiteley, A. A. Brown, and R. R. Taylor; Combustion session (16) — (standing) J. D. McCullough, M. S. Gare, (seated) F. H. Bremmer, G. J. Gockstetter, and A. F. Kritscher; Operating Practice session (17) — (standing) Jerome Strauss, (seated) J. F. Byers, G. B. Brown, and Emil Kern; Lubrication session (18) — (standing) D. E. Whitehead, C. A. Bailey, (seated) A. E. Cichelli, S. S. Sorem, and E. R. Harris, Operating Practice session (19) — (standing) P. E. Thomas, J. K. Seyler, (seated) T. M. Fairchild, A. J. Krombholz, and G. B. Foster, Combustion session (20) — W. A. Pond, F. Bruce Bevelheimer, G. H. Krapf, and F. R. Pullen, and, Electrical session (21) — (standing) D. L. Beeman, T. W. Alexander, Jr., C. B. Risler, (seated) L. V. Black, K. L. Johannsen, R. F. VandenBoom.

In (22) through (29) are a few selected exhibits in the Iron and Steel Exposition. These have been selected as samples of the keen interest shown by those in attendance and the ingenuity of the exhibitors in attracting the attention of the visitors.

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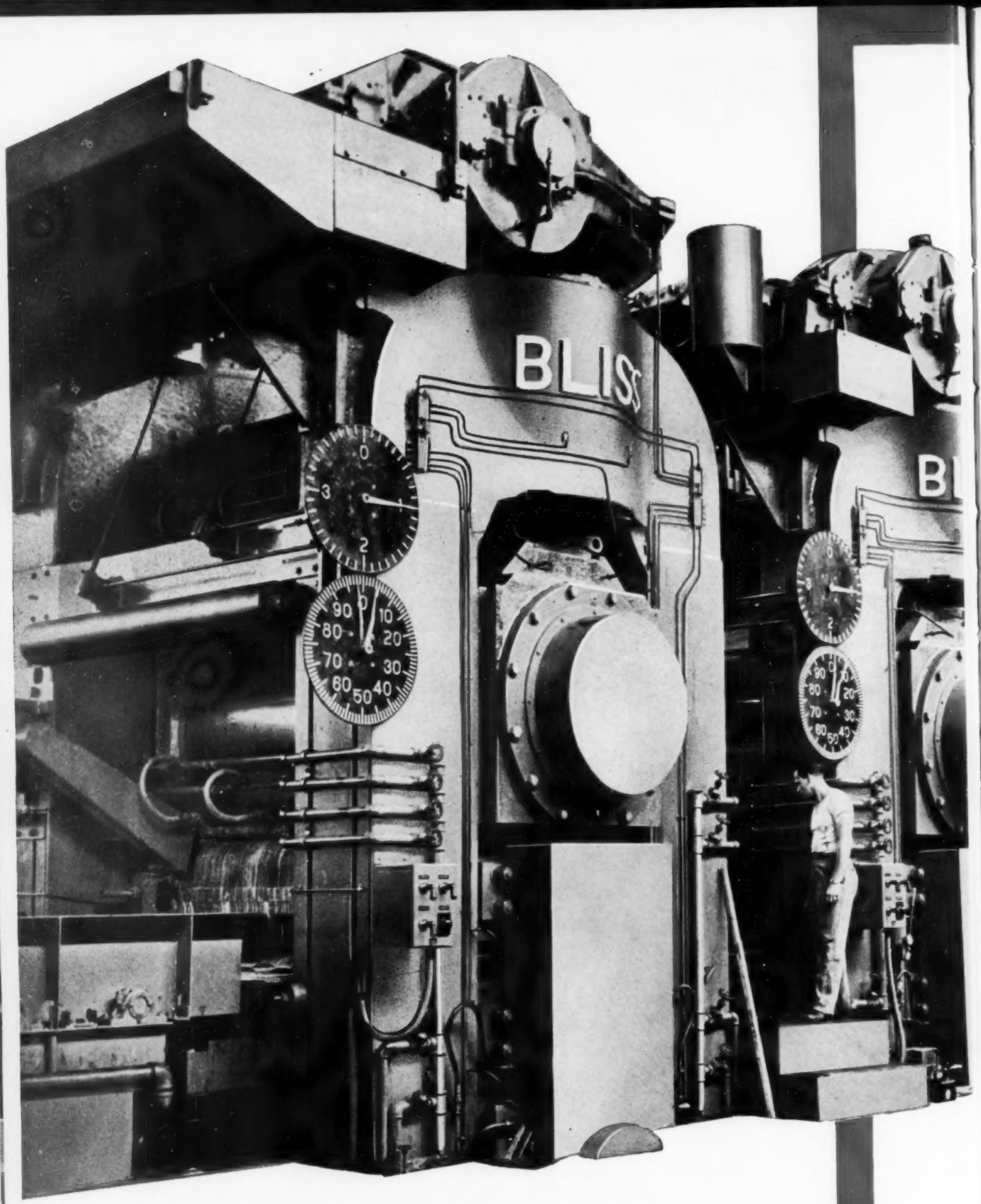
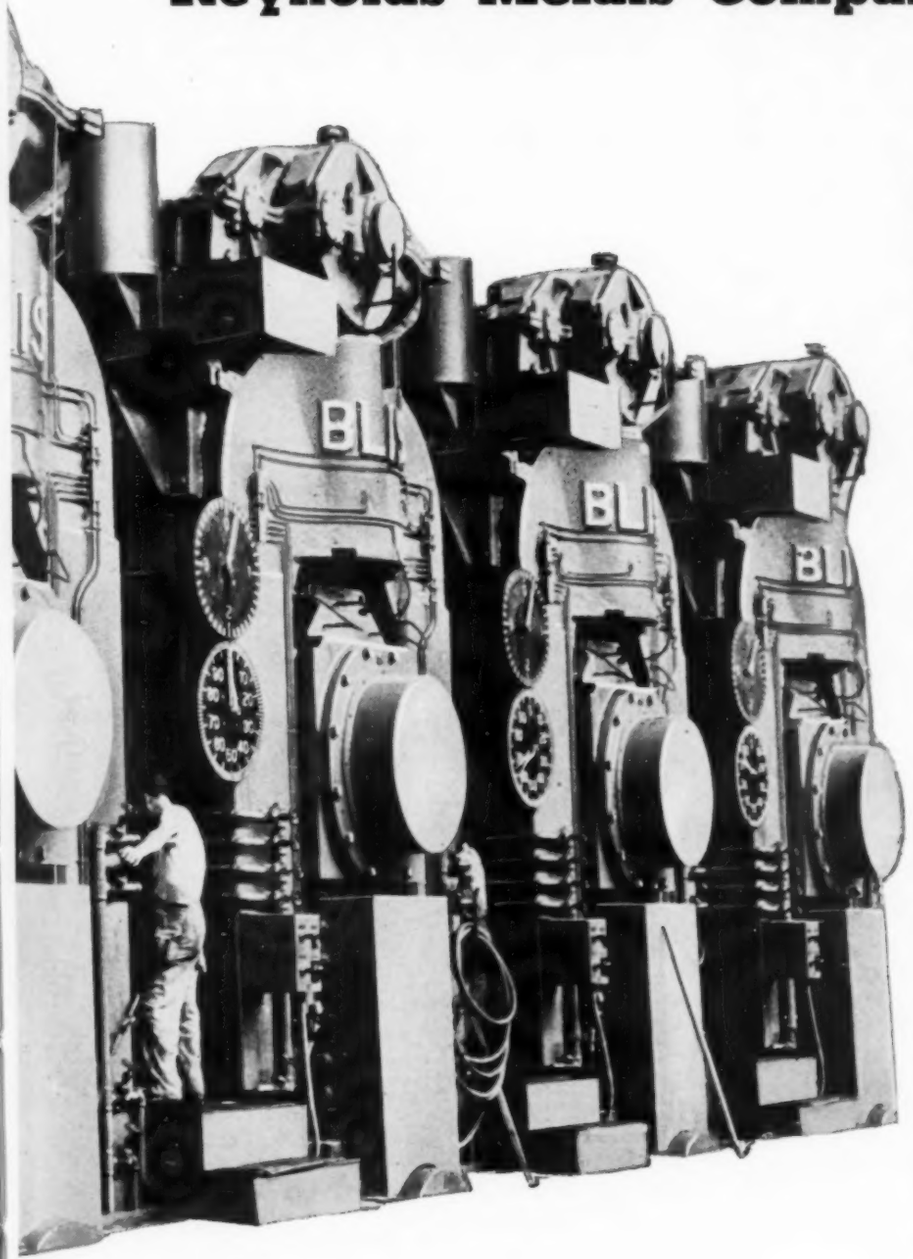


Remember: for Presses, ROLLING MILLS
and Special Machinery... ***It's BLISS!***

BLISS Mill rolls 2,000,000 lbs. of aluminum in eight hours for Reynolds Metals Company



Here's another Bliss rolling mill installation whose *performance* speaks for itself.

For several years a Bliss five-stand, four-high 80″ tandem mill has been hot-rolling huge quantities of aluminum sheet at the McCook (Ill.) plant of Reynolds Metals Company.

This leading aluminum producer has rolled as many as 570 ingots on the Bliss mill in an eight-hour shift. Maximum production, poundage-wise, has exceeded 2,000,000 lbs. in one shift.

The mill is now processing all the material produced on Reynolds' 120″ and 96″ ingot and slab breakdown mills. Average delivery gage is .120″ with a maximum speed of 850 fpm, and minimum width is approximately 24″. Ingot starting sizes vary from 10″ x 30″ to 16″ x 48″.

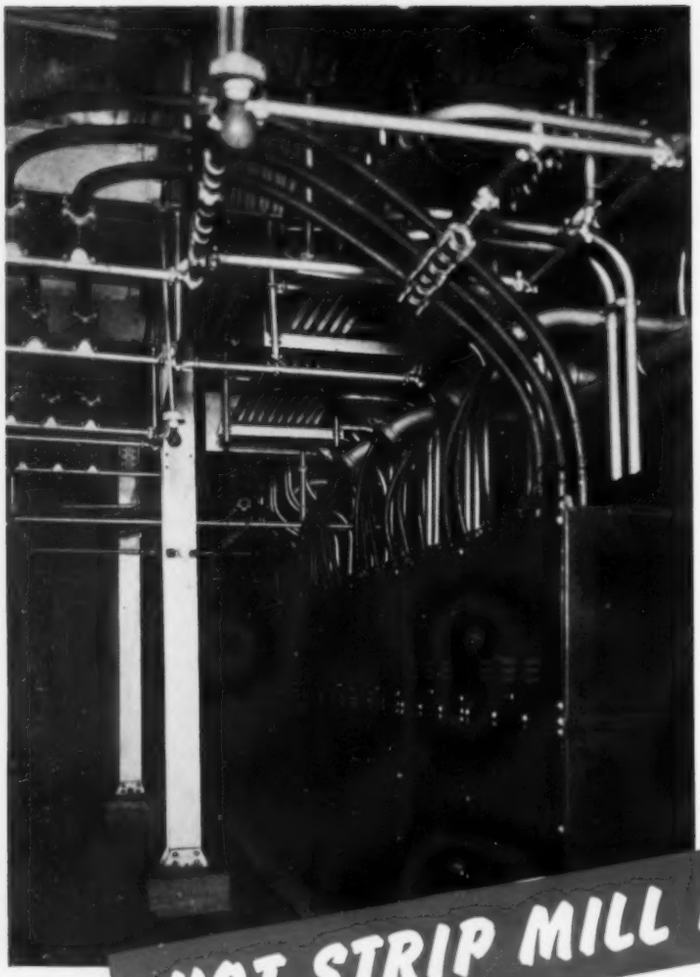
Like Reynolds, other major processors of aluminum, steel and brass are using Bliss rolling mills to step up plant efficiency and boost vital metal production. You, too, will find it's wise to take your metal-rolling problems to Bliss. Get a complete picture of the Bliss line of mills and accessories. Write for our 52-page brochure, Bulletin No. 40.

E. W. BLISS COMPANY, General Office: Canton, Ohio

ROLLING MILL DIVISION: SALEM, OHIO

E. W. Bliss (England) Ltd., Derby, England E. W. Bliss Company (Paris), St. Ouen sur Seine, France

Branch offices in Chicago, Cleveland, Dayton, Detroit, Indianapolis, New Haven, New York, Philadelphia, Toledo, Rochester; and Toronto, Canada. **West Coast Representatives:** Moore Machinery Company, Los Angeles and San Francisco; Star Machinery Company, Seattle. **Other dealers** in United States cities and throughout the world.



WHY IS OKOLITE-OKOPRENE THE CHOICE FOR HOT STRIP MILL POWER CIRCUITS?

HERE ARE SOME OF THE REASONS:

The Okoprene sheath, containing no rubber, will not rot or deteriorate when subject to moisture in underground service. It has better resistance to acids, alkalies, corrosive chemicals — and especially oils — than braid, lead, or other common cable coverings. Will not deteriorate at heats even as high as 167°F. Okolite-Okoprene cables do not require a lead sheath.

The Okolite insulation resists moisture and heat to virtually the same degree as the Okoprene sheath. Millions of feet of Okolite-Okoprene cables, under the toughest service conditions, have proved their superior insulating strength, aging properties and stability.

Okonite cables are the only cables on the market on which the insulation and sheath are applied by the strip process. This method of application makes a profound difference in the cable's endurance. For instance, the insulation is not "worked" as it must be for the extrusion method; insulation and covering are applied in one operation and vulcanized but once; a much more dependable bond between the two is thus obtained.

Most conclusive evidence of Okonite cable superiority is the a-c and d-c super-voltage testing routinely applied during its manufacture — the highest voltage cable testing in use anywhere. No other cable manufacturer offers this positive assurance for trouble-free service.

Much of the $50,000,000 worth of electrical equipment to go into steel mills this year will be served by Okonite wires and cables. Bulletin IS-1053 gives *all* the reasons why. Write for this bulletin today, to The Okonite Company, Passaic, N. J.

OKONITE

OKONITE SINCE 1878

THE BEST CABLE IS YOUR BEST POLICY

insulated wires and cables

MOSES WINS 1952 KELLY AWARD

▲ AT the annual meeting of the Board of Directors which was held on September 29th, the prize winning Kelly Award papers for 1951 were selected. Winner of the first prize was Louis Moses for his paper "A Report of Rolling Experiences." At the time of writing the paper Mr. Moses was superintendent of the rail mill and roll department, Bethlehem Steel Co., Sparrows Point, Md. The paper was originally published in the January 1951 issue of the Iron and Steel Engineer.

Second prize was awarded to F. H. Wickline, then construction engineer-electrical for the National Tube Co., Lorain, Ohio, for his paper "Requirements for a Modern Steel Mill Power Distribution System." This paper was printed in the August 1951 Iron and Steel Engineer.

John R. Chegwidden, formerly superintendent of Saucon mills, Bethlehem Steel Co., Bethlehem, Pa., and now assistant superintendent, Saucon division, Bethlehem Steel Co., Bethlehem, Pa., was awarded third place for his paper "Effect of Track Time on Soaking Pit Heating," first published in the December 1951 Iron and Steel Engineer. There were many excellent papers, and the committee had a difficult job in making their selections. Other papers which were runner-ups were "Modern Blooming Mill Practices," by D. W. Lloyd, general superintendent, Brier Hill works, Youngstown Sheet & Tube Co., Youngstown, Ohio, and the "Continuous Seamless Pipe Mill," by John L. Young, vice president-engineering, United States Steel Co., Pittsburgh, Pa.

The Kelly Award carries prizes of $300, $200, and $100 for first, second and third place, respectively. The award was established September 28, 1943 to honor John F. Kelly, managing director of the AISE from 1917 to 1934, and to perpetuate the memory of his achievements in the advancement of the Association.

The award is made each year by the Board of Directors of the AISE upon the recommendations of the editorial and executive Committees of the Association.

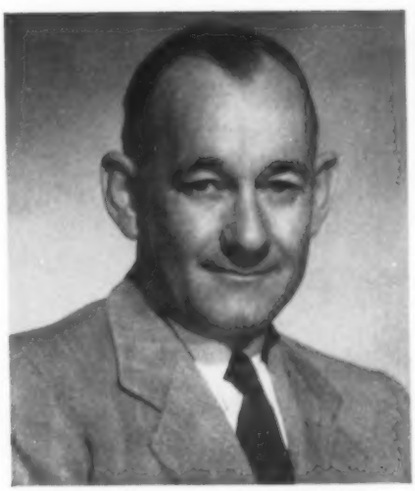
Rules of the Award:

1. The Award shall be given annually to the author of the paper, adjudged of greatest value in the advancement of engineering or operating practice in the iron and steel industry.
2. The entries for each judging shall be the papers published in the Iron and Steel Engineer during each calendar year, although some may have been presented at meetings in the previous year.

   Voluntary contributions of papers not presented at meetings but published by the Association are also included in the judging.
3. To be eligible for the Award, the author must be directly employed in the iron and steel producing industry. The author need not be a member of the Association of Iron and Steel Engineers.
4. The Award shall be made at the annual fall meeting following the close of the calendar year.
5. The Award shall be made by the Board of Directors of the Association on the recommendation of the executive committee of the Association.

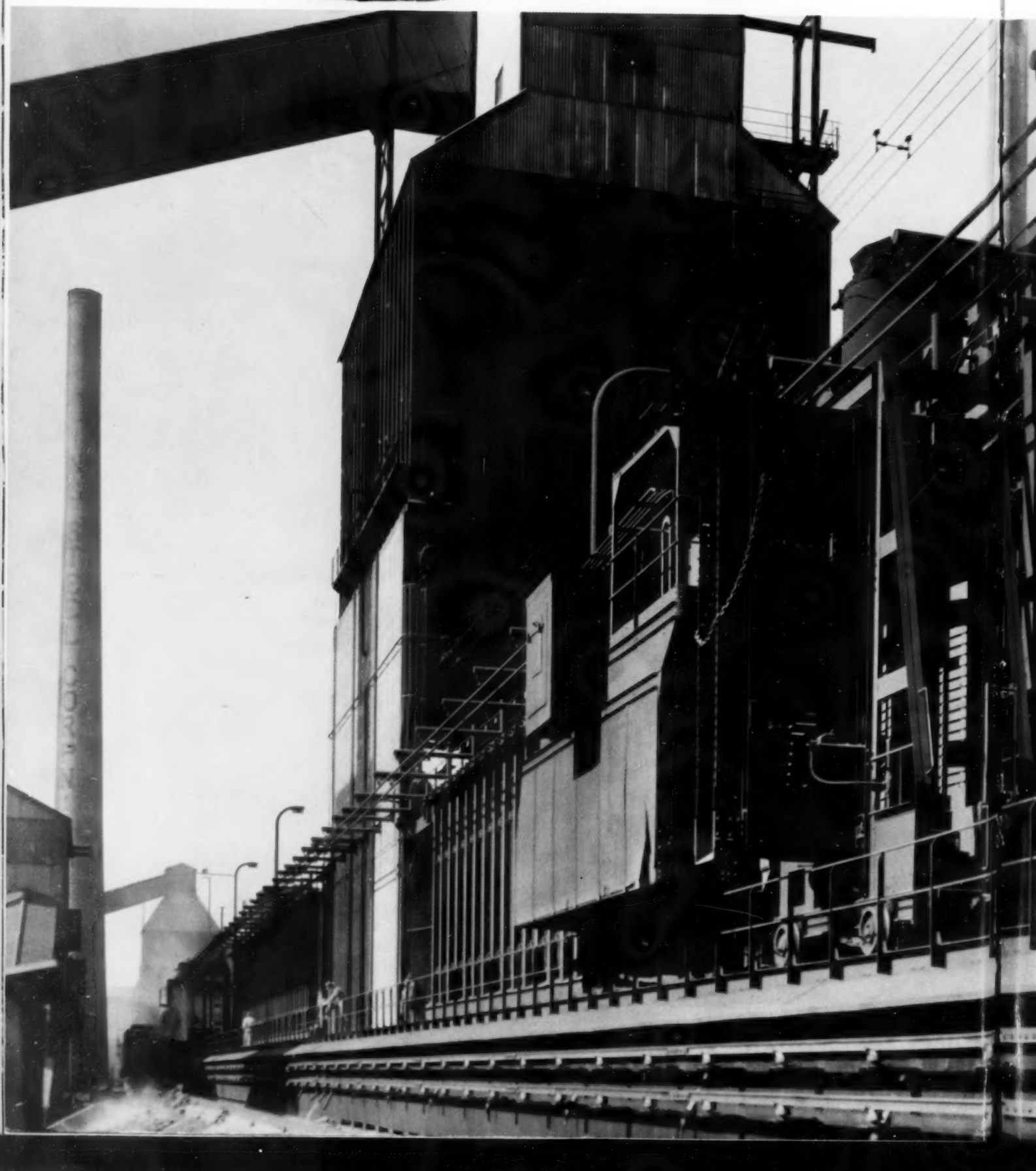
LOUIS MOSES

F. H. WICKLINE

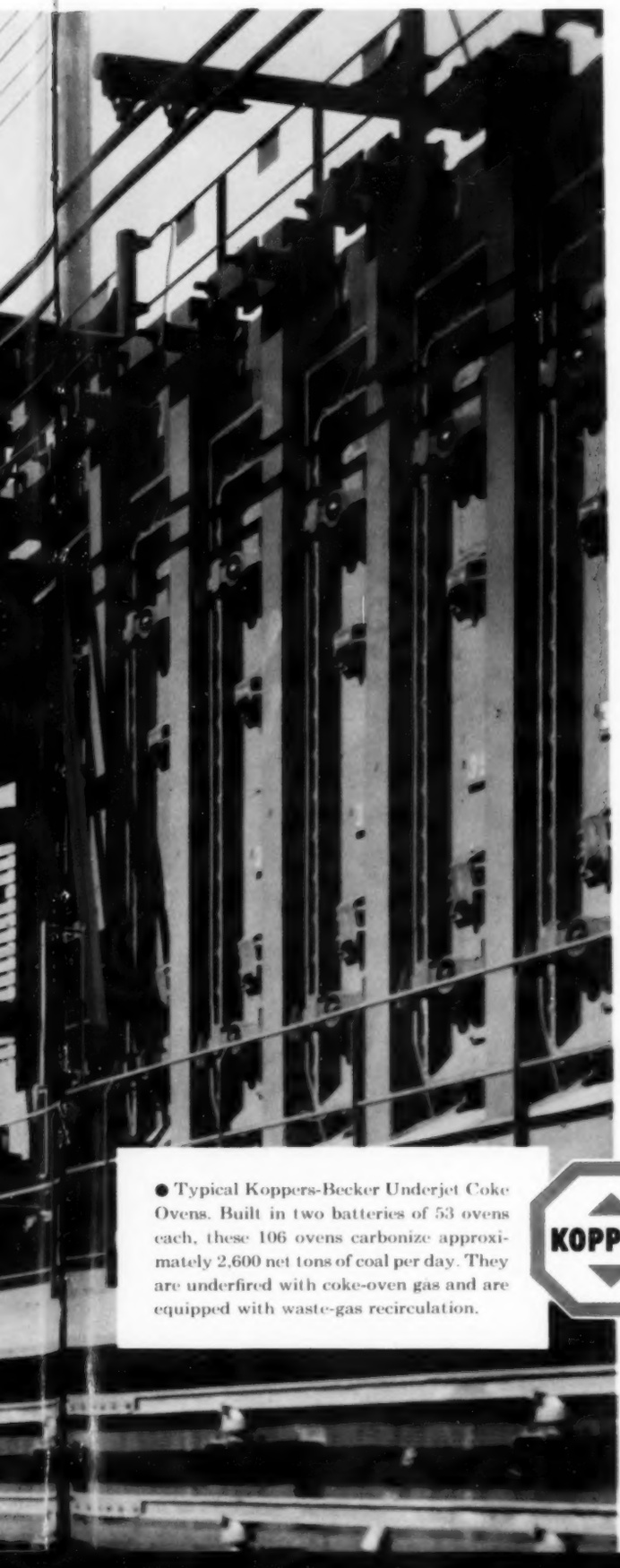


JOHN R. CHEGWIDDEN

A B C's of



good coke-oven construction



● Typical Koppers-Becker Underjet Coke Ovens. Built in two batteries of 53 ovens each, these 106 ovens carbonize approximately 2,600 net tons of coal per day. They are underfired with coke-oven gas and are equipped with waste-gas recirculation.

A good basic design

The efficiency of any coke oven hinges entirely on its design. We believe that Koppers-Becker Coke Ovens have the best basic design. As a result, these ovens are sturdy, free from complications, simple to control. They also have the largest practical coking capacity.

This basic design meets diversified conditions. It can be employed when heating by any kind of fuel gas normally available, when building large or small ovens. This design results in low maintenance and in long life.

B constant engineering refinements

Koppers builds a great many coke-oven plants and is therefore in a position to anticipate new needs. For example, the waste-gas recirculation system was developed by us to meet the need for uniform heating when using rich fuel gas.

C skilled engineering staff

There is no substitute for a skilled engineering staff. Through the years, our engineers have proved their ability to design and erect the most advanced and efficient coal-carbonization equipment . . . material-handling systems . . . gas-treatment equipment.

Constructing coke ovens and related equipment is just one way in which Koppers serves the steel industry. For any kind of metallurgical construction, you can count on Koppers. You are invited to consult with our Engineers and Management.

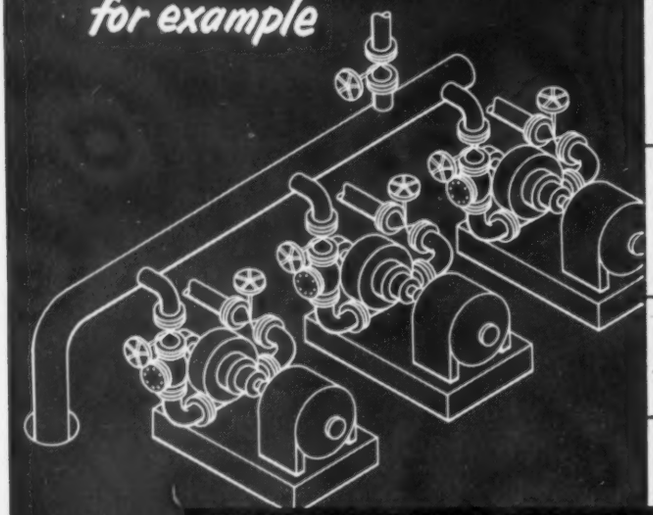
KOPPERS

Engineering and Construction Division

KOPPERS COMPANY, INC., PITTSBURGH 19, PA.

Can You Trust Your Checks to Hold Like This?

. . . on Water Pumps, for example



THE INSTALLATION

Crane Iron Body Swing Check Valves in 8-inch vertical lines on discharge side of water pumps supplying a large eastern paper mill.

VALVE SERVICE RATINGS

SUITABILITY:	Working smoothly - no complaints
FEATURES:	O.K. for either horizontal or upward flow
MAINTENANCE COST:	None - no maintenance needed to date
SERVICE LIFE:	Now better than other checks used
OPERATING RESULTS:	No water or head loss
PRICE:	In line with other makes
AVAILABILITY:	Stock item - Crane product

THE HISTORY

The mill depends on these pumps for all water. Loss of head at the pumps would create a serious problem. The mill could take no such risks. Regularly, the check valves on pumps were replaced, but only to be found leaking between pumping cycles, a few months later.

It's now more than a year since the change-over was made to Crane Check Valves. There's been no loss of water, no maintenance or replacement of any checks on the pumps. That was proof enough for the mill, that Crane Quality means better valves —greater dependability and bigger value. As a result, 3 more of these checks were installed on a separate battery of suction pumps.

THE VALVE

Crane No. 373, 125-Pound Iron Body Swing Check Valves, brass trimmed. The long life and high seating efficiency of these checks, in 2 to 8-in. sizes, is in large part due to the Crane patented flexible disc-hinge design. Double spring mounting eliminates lost motion between parts, yet permits true, full contact of disc and seat at every closure. Also serves to absorb the shock of seating under back-flow pressure. See your Crane Catalog or Crane Representative for full details.

The Complete Crane Line Meets All Valve Needs. That's Why

More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois

Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Tough Insulator Problem?

HERE'S YOUR ANSWER!

NEW KEYSTONE GLASTIC INSULATORS

WITHSTANDS IMPACT AND SHOCK—Has superior physical and dielectric properties.

RESISTS HIGH HEAT—Withstands operation under maximum sustained temperatures up to 300°F

NON-ABSORBENT — Resists chemicals, most acids, salts and hydrocarbons.

Put new Keystone GLASTIC Insulators to work on your tough insulator problems! Where installation requirements demand extra strength and longer life, Keystone GLASTIC Insulators offer greater cantilever strength, increased puncture strength, and exceptional resistance to arc tracking.

Glass fiber construction imparts ability to resist impact, thermal shock and vibration. GLASTIC Insulators are unaffected by moisture, high heat, chemicals and rough handling. You get advantages not obtained with insulators of phenolic composition. GLASTIC Insulators can be designed to your individual requirements.

The new GLASTIC Insulator is one of a complete Keystone line available for use with rail, wire or angle conductors in either over-running or under-running operation.

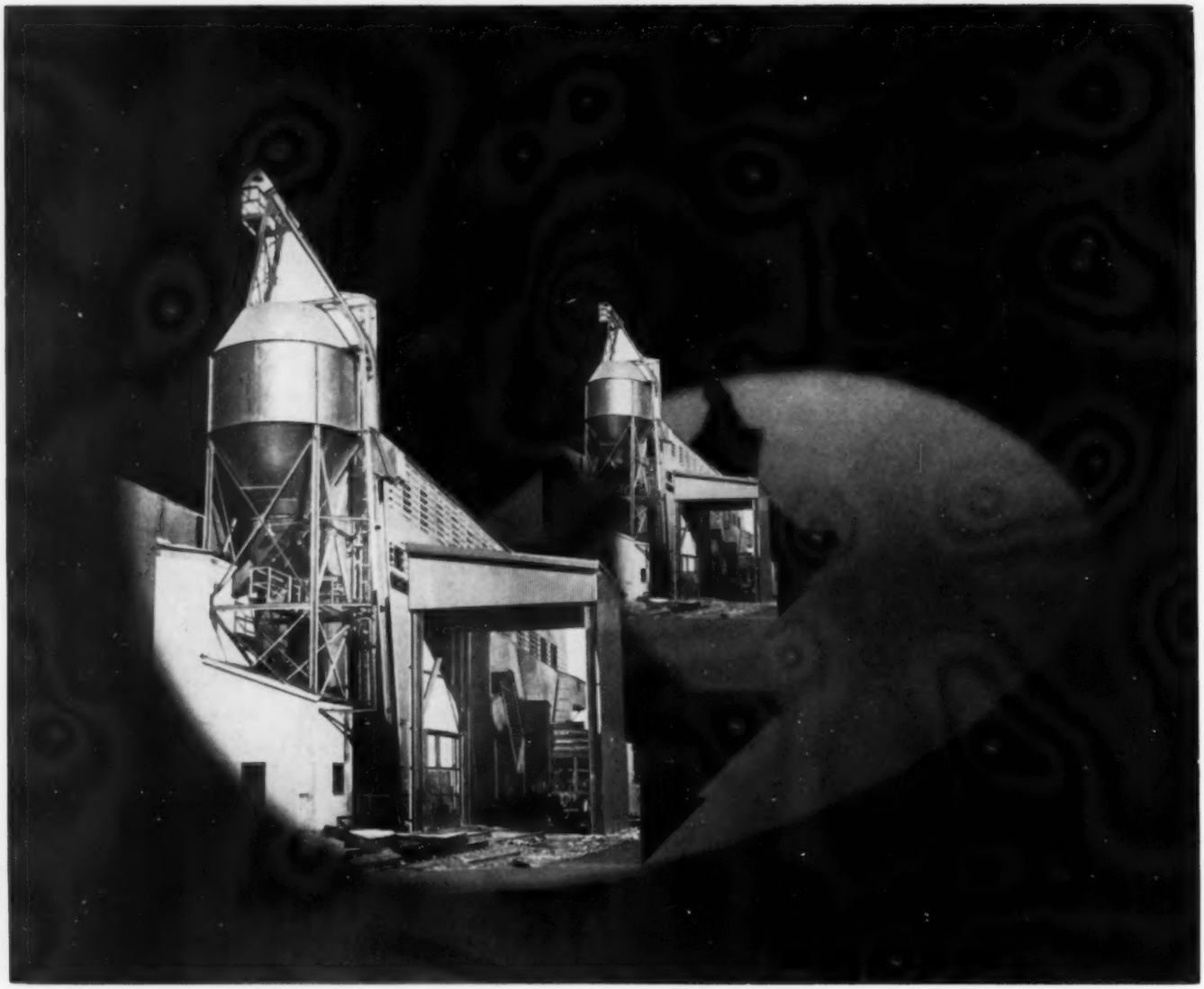
SEND FOR BULLETIN

ELECTRIC SERVICE MANUFACTURING CO.

PHILADELPHIA 32, PENNA.

REPRESENTED IN CANADA BY LYMAN TUBE AND BEARING, LIMITED, MONTREAL AND TORONTO

MANUFACTURERS OF COMPLETE LINE OF INSULATOR SUPPORTS FOR RAIL AND WIRE CONDUCTORS AND CURRENT COLLECTION DEVICES.



U. S. STEEL GETS ANOTHER ROBERTS AND SCHAEFER COKE BREEZE PLANT

- **Now in operation:** one R&S coke breeze storage and service plant at United States Steel Company, Gary Steel Works. Performance: good . . . per-ton operating costs reduced.
- **Results:** an order for another plant, identical to the first, for installation at the new Fairless Works.
- **Moral:** When you have engineering and construction problems connected with bulk material handling and processing, consult Roberts and Schaefer Company — *a business built on repeat orders from customers who got what they wanted the first time.*

Serving the steel industry for more than 25 years . . .

R AND S COMPANY

ROBERTS and SCHAEFER CO.

ENGINEERS AND CONTRACTORS • 130 North Wells Street, Chicago 6, Illinois

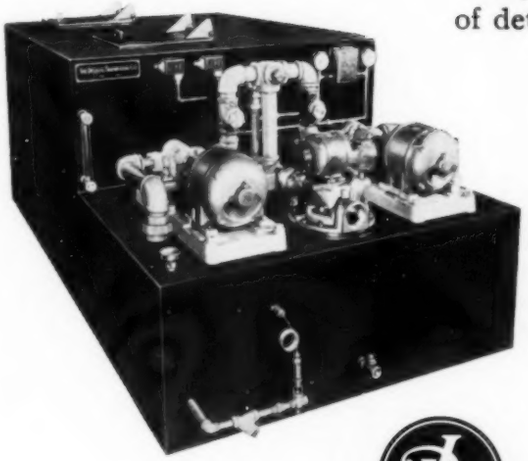
PITTSBURGH 22, PA. • NEW YORK 19, N. Y. • HIBBING, MINN. (Box 675) • HUNTINGTON, W. VA.

WHENEVER MILL BEARINGS AND GEAR MESHING POINTS NEED TO BE LUBRICATED

. . . CALL DE LAVAL!

De Laval engineers are ready to design a custom-built lubrication system for large mills, or to recommend the proper size Unilube System for smaller mills. All De Laval designed mill lubrication systems have all the essentials: correct metering of lubricant; constant streamline flow of lubricant in the correct quantity and pressure; proper pipe size; efficient temperature control. De Laval engineers, through nearly three decades of experience, have designed lubrication systems for some of the best known mills in the country.

It is not just knowing the fundamentals that counts . . . important, too, are the many small details that collectively make the difference between a system that gives no trouble at all and one that is a constant source of worry. De Laval engineers appreciate the importance of details!



Custom-built mills, of course, may be of any size; Unilube Systems, all piped and ready to install, are available in four models in capacities up to 50 gallons per minute. All will handle oil of any viscosity.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL SALES & SERVICE, INC.
447 Fourth Ave., Pittsburgh 19
DE LAVAL PACIFIC COMPANY
61 Beale St., San Francisco 5

DE LAVAL ENGINEERED SYSTEMS

This is *PRECISION*

A-C Crane Hoist Control

15 Tons of Steel . . . handled as though it weighed a pound. The picture at the right tells the story. A walnut and wrist watch were placed side by side. The operator lowered the 15-ton, full-hook load. The walnut was cracked. Then the load was raised without the least settling action. The watch was left untouched.

That's Precision . . . precision that is attained on all cranes equipped with the new Westinghouse Load-O-Matic Crane Control. In this particular test, the load was lowered with the master switch set at the first point lower. No jogging, inching or retardation was necessary—lowering rate was smooth and steady.

The Load-O-Matic hoists and lowers *all* loads—the empty hook, light or maximum loads—at stabilized speeds. Loads can be brought to a standstill or suspended by action of the motor only.

VERNIER CONTROL PROVIDES FLEXIBILITY

Additional flexibility of operation is available with the auxiliary Vernier control. This control component is especially useful for high-accuracy spotting. For example—with full load on the hook and the master switch on the first lowering point, operation of the Vernier provides control from approximately 7% of full speed to standstill. Operator can actually float the load into the desired spot.

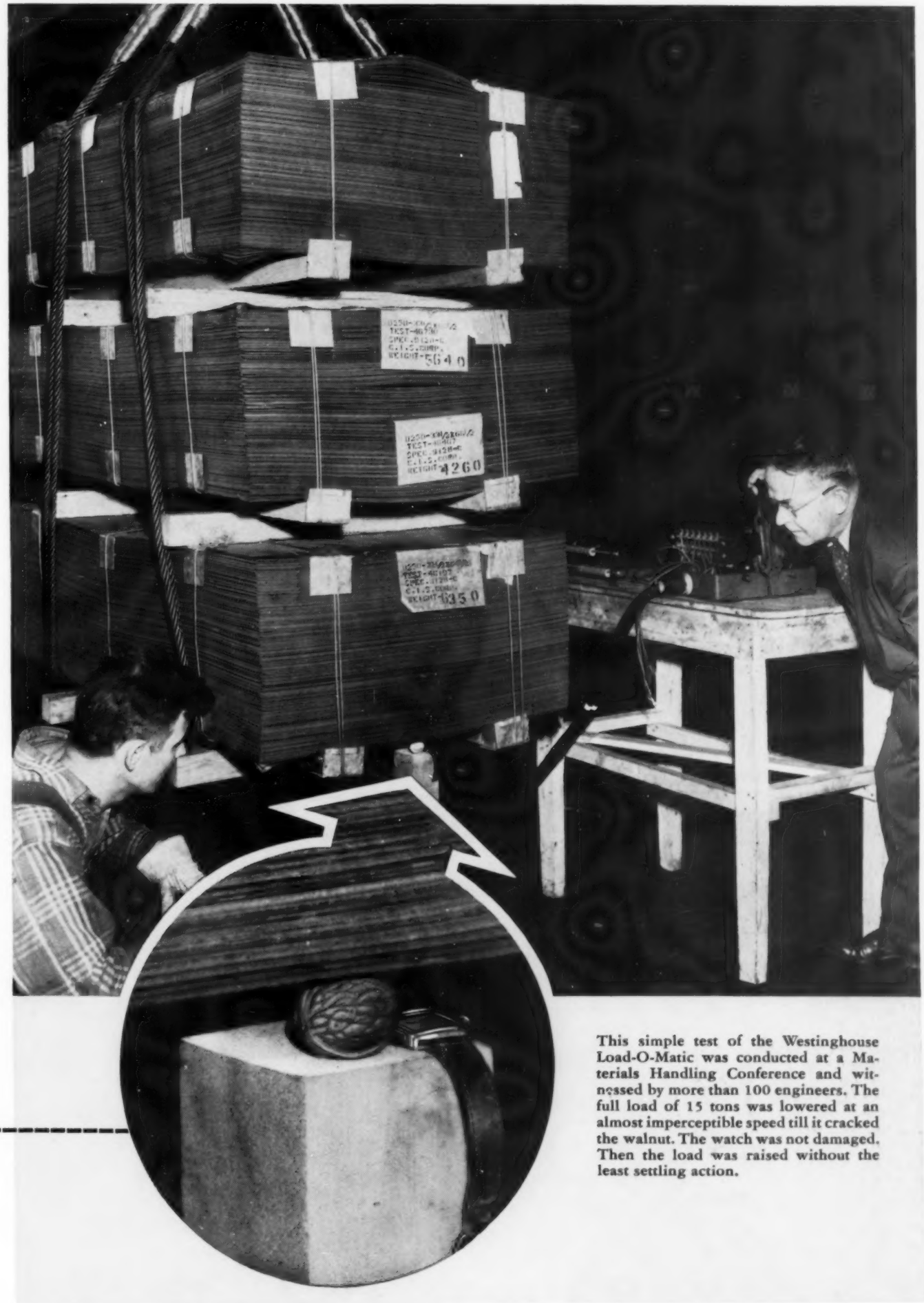
ASK FOR DESCRIPTIVE BOOKLET B-5417

This booklet describes all the operating characteristics and features of the Load-O-Matic a-c crane hoist control. Ask your Westinghouse representative for your free copy, or write direct to: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27015

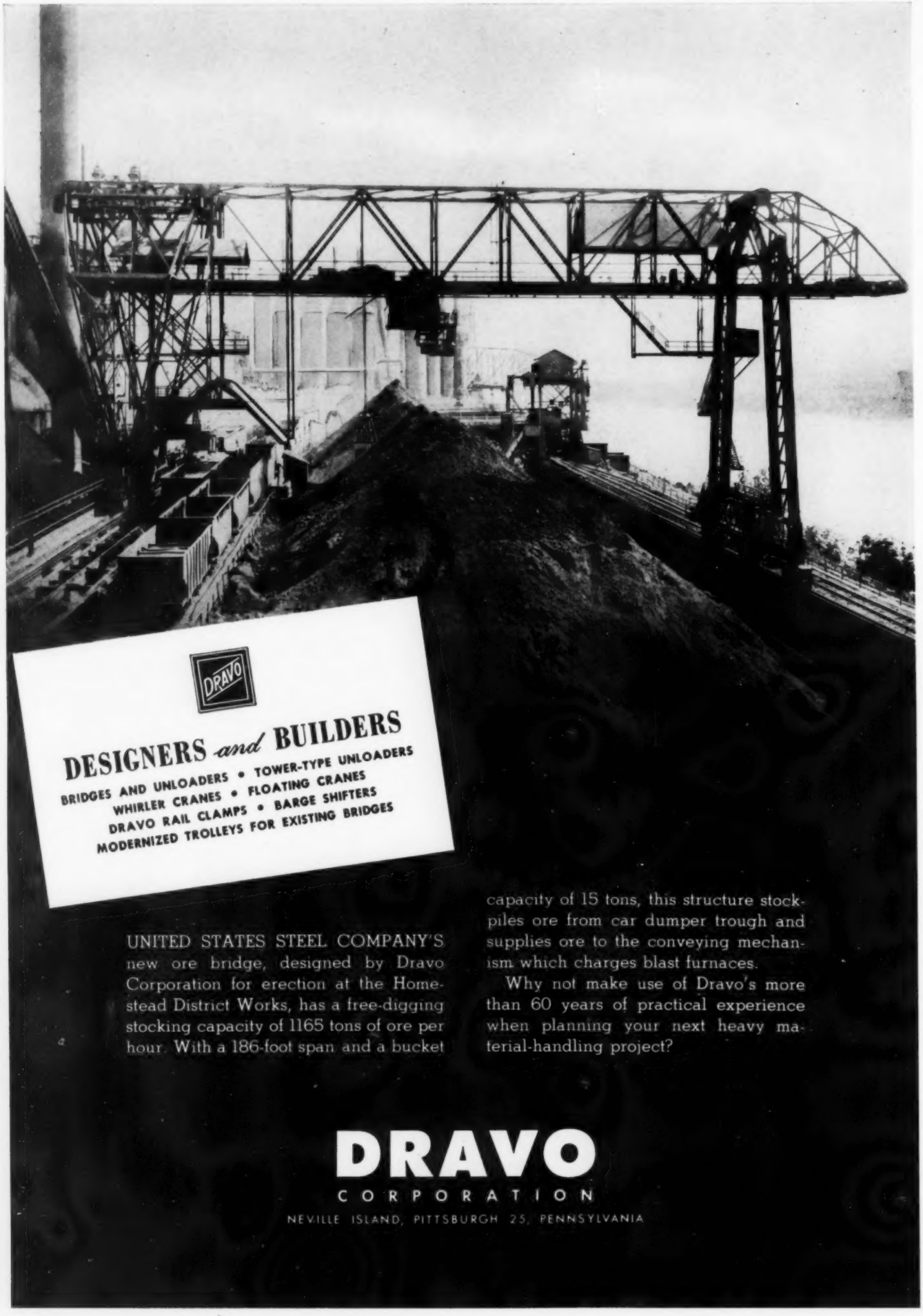
YOU CAN BE SURE...IF IT'S

Westinghouse

CRANE CONTROLS



This simple test of the Westinghouse Load-O-Matic was conducted at a Materials Handling Conference and witnessed by more than 100 engineers. The full load of 15 tons was lowered at an almost imperceptible speed till it cracked the walnut. The watch was not damaged. Then the load was raised without the least settling action.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DESIGNERS and BUILDERS
BRIDGES AND UNLOADERS • TOWER-TYPE UNLOADERS
WHIRLER CRANES • FLOATING CRANES
DRAVO RAIL CLAMPS • BARGE SHIFTERS
MODERNIZED TROLLEYS FOR EXISTING BRIDGES

UNITED STATES STEEL COMPANY'S new ore bridge, designed by Dravo Corporation for erection at the Homestead District Works, has a free-digging stocking capacity of 1165 tons of ore per hour. With a 186-foot span and a bucket capacity of 15 tons, this structure stockpiles ore from car dumper trough and supplies ore to the conveying mechanism which charges blast furnaces.

Why not make use of Dravo's more than 60 years of practical experience when planning your next heavy material-handling project?

DRAVO
CORPORATION
NEVILLE ISLAND, PITTSBURGH 25, PENNSYLVANIA

Wagner
CRANE-BRIDGE BRAKES
...the choice of leaders in industry

Your cranes are *safer* when equipped with

Wagner

CRANE-BRIDGE BRAKE SYSTEMS

Your operators have full control of cranes when Wagner *Hydraulic* Crane-Bridge Braking Systems are installed. They stop your crane the way you stop your car—simply—positively—safely. Wagner Hydraulic Brakes provide even the heaviest steel mill ladle cranes with controlled deceleration for smooth, precise stops.

NEW

Snap-Acting Switch assures complete dependability

Wagner Type HM-2 Crane-Bridge Brakes are equipped with a *positive* limit switch that is mechanically operated by the piston rod of the releasing cylinder. Switch is snap-acting —no slow make-or-break contacts.

Safe while operating...Safe while parked

The new Wagner Type HM-2 Bridge Brake System provides operator-controlled hydraulic braking for service stops and spring-set braking for parking. The new limit switch positively holds the parking brake in released position, until it is set by the operator. The parking brake also sets automatically, to bring the crane to a gradual stop, in case of power failure. Limit switches can be used to automatically set the brake as the crane approaches the end of the runway.

The operator always knows when the parking brake is released because a signal light is illuminated only when the setting spring is fully compressed.

* * *

Only Wagner Hydraulic Braking Systems are equipped with the remote control bleeder that keeps the lines full of fluid and makes bleeding the system a simple "one-man one-minute" job, and only Wagner offers the self-centering device that prevents brake shoe drag by automatically assuring equal clearance of both shoes. Other features include one-point shoe adjustment, 200% emergency torque, and non-scoring molded lining blocks that are easily replaceable.

If your cranes are not equipped with Wagner Brakes, we can show how simple it is to install a modern hydraulic system. If you still have old-style Wagner Brakes, your system can be easily modernized with our complete conversion kits. Bulletin IU-40 gives full information—write for your copy.

Replacement Lining and Brake Wheels

Wagner offers the perfect combination of brake wheel and non-scoring lining for replacement needs. Wagner Brake Lining is specially designed and manufactured to meet the exacting service requirements of industrial braking. It is available in rolls, blocks, and discs.

WAGNER ELECTRIC CORPORATION
6483 Plymouth Ave., St. Louis 14, Mo., U.S.A.

Wagner Electric Corporation
EST. WE 1891

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

152-2

SHELL INDUSTRIAL

bring greater under extreme

FOR GEARS...

SHELL MACOMA OILS

FOR ENCLOSED GEARS, Shell Macoma Oils solve the problem of extreme pressure lubrication with *seven distinct advantages:*

1. Extreme load carrying capacity . . . remarkable ability to prevent wear and seizure . . . even after long periods under heavy load.

2. Long-lasting oxidation stability . . . plus freedom from sludge formation in the presence of water.

3. Outstanding adhesion . . . maximum protection against rust, and against leakage through worn bearings and seals.

4. Non-corrosive . . . will not cause corrosion of steel or alloy bearings.

5. Non-Foaming . . . Shell Macoma Oils successfully overcome the tendency to foam caused by aeration of oil in the gear chamber.

6. Speedy water separation.

7. Complete stability in storage and in service . . . no tendency to separate, even in extremes of heat and cold.

SHELL

Be sure to get all the facts about these Shell Macoma Oils. Check the coupon and attach to your letterhead for full information.

Two great products of

EP LUBRICANTS

safety to gears and bearings loads and adverse conditions

FOR BEARINGS...

SHELL ALVANIA EP GREASE

FOR GREASE-LUBRICATED bearings, Shell Alvania Grease . . . the one grease that serves *all* grease applications in the majority of plants . . . *now is available with EP qualities added! . . . now even more Multi-Purpose.*

All of these unique advantages of Alvania Grease are therefore available for the first time to operators of machines subject to extreme bearing pressures:

1. Higher mechanical stability than any conventional grease at operating temperatures.

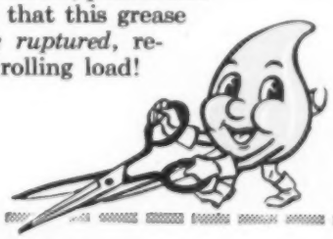
2. Pumpable at low temperatures . . . even through centralized lubrication systems.

3. Stable at high temperatures . . . no phase changes—still a grease at high temperatures—still a grease upon cooling.

4. Resistant to water . . . won't wash out.

5. Longer service life . . . reduced consumption.

Shell Alvania EP Grease is the answer to some of the toughest lubricating problems in industry. In rolling operations, for example, operators of steel, rubber, plastic and paper mills report that this grease film *just won't be ruptured*, regardless of shock rolling load!



Check the coupon and mail today for additional information about Shell Alvania EP Grease.

Shell Oil Company
50 West 50th Street, New York 20, N. Y.;
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☐ Shell Macoma Oils ☐ Shell Alvania EP Grease

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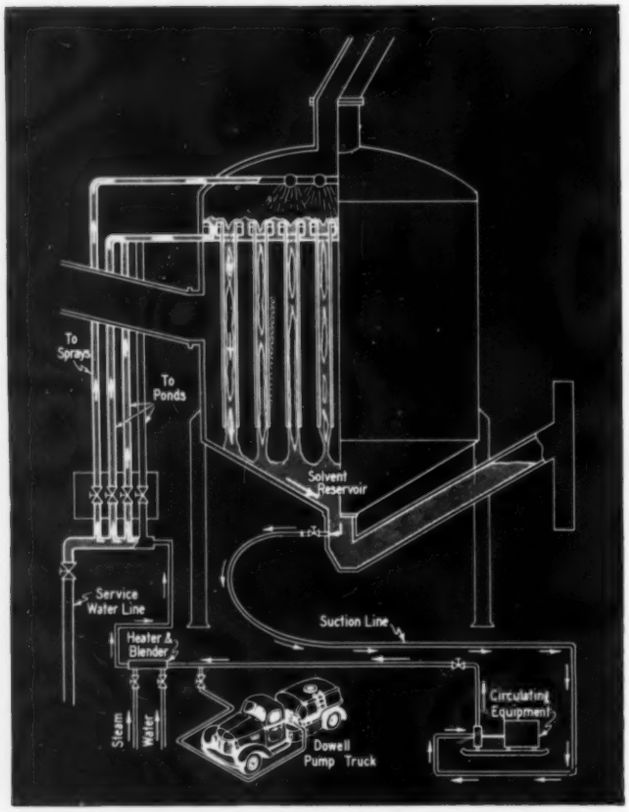
SHELL OIL COMPANY

Electrostatic Precipitators Cleaned in Just 12 Hours

Dowell Service Saved 178 Hours of Downtime by Cleaning with Chemicals



A diagramatic sketch showing hook-up for cleaning precipitators. Dowell Service engineers bring all necessary chemicals, pumps and other equipment right to the job.

Saving downtime is more important than ever. That's why Dowell Service is specified for maintenance cleaning by an ever-increasing number of companies.

One steel company had a series of precipitators with the usual collection of caked dust and corrosion products. To clean by reaming and scraping would have taken an estimated 190 hours. Dowell Service removed the deposits by flooding weirs and ponds with specially prepared solvents. *The job was completed in just 12 hours!*

An unusual case? Not at all! A check list of steel mill equipment reveals 50 different pieces of equipment that have been cleaned chemically by Dowell Service.

Free Bulletin on Chemical Cleaning for Steel Mill Equipment

Send today for this informative bulletin on steel mill maintenance cleaning. Contains descriptive case histories plus handy check list of equipment cleaned by Dowell. Write to Dept. 228, Tulsa, Oklahoma.

Dowell Service

Over 90 Offices to Serve You with Maintenance Cleaning for:

Boilers • Condensers • Heat Exchangers • Gas Mains
Stoves • Furnace Cooling Systems • Piping Systems • Gas Washers • Process Towers • Ammonia Scrubbers • Precipitators
Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED
Tulsa 1, Oklahoma

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

Date-line Diary...

September 2

▲ Based on reports of companies having 93 per cent of the capacity of the steel industry, the operating rate is scheduled at 100.0 per cent of capacity for the first time since May 26. This is equivalent to 2,077,000 tons of steel ingots and castings compared with actual production of 2,069,000 tons one week ago, when the operating rate was 99.6 per cent of capacity.

September 3

▲ Lake Superior Iron Ore Association reported that for the first seven months of 1952, total iron ore used was 39,274,017 gross tons compared with 51,185,226 tons one year ago for the same period. Iron ore used in June and July dropped to about 1,500,000 tons each month due to the steel strike which affected 85 per cent of the country's steelmaking capacity.

September 4

▲ According to Commerce Secretary Sawyer, total civilian employment in August totaled 62,354,000, up 120,000 over July.

▲ The DPA announced that in the week ending August 27, 107 certificates of necessity for accelerated amortization were authorized for $24,960,871 worth of new and expanded defense projects.

▲ North Atlantic Continental Freight Conference offered a 10 per cent reduction in freight rates to shippers across the North Atlantic, which applies to almost all categories of freight except bulk materials.

September 5

▲ Pig iron makers were formally authorized by OPS to raise by $2.50 a ton their ceilings on pig iron containing less than 5 per cent silicon. An increase of $3.00 a ton was permitted for pig iron containing more than 5 per cent silicon.

▲ An investment of $700,000,000 is planned by Aluminum Co. of America for its Alaskan smelting plant. I. W. Wilson, president, said that the ultimate capacity of the installation would be 800,000,000 lb of aluminum annually. It will take four years to complete the project.

▲ The Aluminum Association reports that United States primary aluminum production in July amounted to 156,735,591 lb, and exceeded the June output by approximately 2,000,000 lb. Shipments of aluminum sheet and plate totaled 85,049,202 lb in July.

September 6

▲ Henry H. Fowler, present chief of the Defense Production Administration, has been named by President Truman to head the top policy-making Office of Defense Mobilization, which post has been vacant since April when Charles E. Wilson resigned.

▲ According to Ward's Automotive Reports present schedules call for assemblies of 1,200,000 cars in the last three months of 1952.

▲ Directors of the Granite City Steel Co. decided to eliminate the common dividend for the third quarter because of the steel strike.

September 8

▲ Increases up to 11 per cent for salaried employees in steel producing and distributing operations of United States Steel Co. was announced by Benjamin F. Fairless, president of the company, and will be retroactive to March 1, 1952.

▲ Based on reports of companies having 93 per cent of capacity for the steel industry the operating rate is scheduled to be 101.5 per cent of capacity for the week beginning September 8. This is equivalent to 2,108,000 tons of steel ingots and castings compared with 2,055,000 tons one week ago.

September 9

▲ The Commerce Department announced that business inventories dropped in July. At the end of July, seasonally-adjusted inventories totaled $69,300,000,000. The greatest drop was in durable goods.

▲ The blast furnace hearth of Republic Steel Corp., South Chicago, Ill., is being increased one ft to 28 ft, which will boost its capacity to 1350 tons of iron per day from 1275 tons. The furnace will be down for sixty days to make these improvements.

September 10

▲ According to AISI, the average hourly earnings for wage earners in May were $1.971, and they averaged 36.1 hrs a week compared with an average of 40 hrs a week in the previous four months. Total employment in the iron and steel industry for May was estimated at 662,600, and total payroll was estimated at $223,148,000. This information is based on reports from 110 companies representing 95 per cent of the capacity of the industry.

▲ The Commerce Department reported that personal income dropped in July. Personal income for the first seven months of 1952 was at an annual rate of $264,000,000,000, which was 5½ per cent higher than the same period in 1951.

▲ Estimated net income of Class I Railroads reached $36,000,000 in July.

▲ The British Iron and Steel Federation announced that Britain's steel production continued to rise in August, and that output was at a yearly rate of 14,535,000 tons compared with 13,855,000 for the same period in 1951.

September 11

▲ According to the American Railway Car Institute, August freight car deliveries totaled 4537 compared with 7183 in July. Orders for new freight cars totaled 4558, and the backlog of orders as of September 1 was 95,761.

▲ Further expansion of the Pittsburgh Works is planned by Jones & Laughlin Steel Corp. The Pittsburgh Urban Redevelopment Authority will assist the company in securing 34 acres of land for this purpose.

▲ The consummation of an RFC loan in the amount of $45,000,000, authorized last June, was announced by the Detroit Steel Corp.

▲ Benjamin F. Fairless, chairman and president of United States Steel, and Philip Murray, head of the CIO Steelworkers, plan to tour U. S. Steel plants in an effort to find a better way to settle disputes.

▲ Commercial production of copper-clad steel plate has been initiated at the Coatesville plant of Lukens Steel Co.

September 12

▲ An increase of 75¢ on a long ton of iron ore mined in the Lake Superior district of Minnesota, Wisconsin and Michigan was authorized by the OPS.

September 13

▲ The price of zinc in East St. Louis increased ½¢ to 14½¢ a lb.

▲ A warehouse building and apparatus service shop at an estimated cost of $1,600,000 will be built by General Electric Co. in Philadelphia, Pa.

▲ Koppers Co., Inc. has been awarded a contract for a battery of 57 chemical-recovery coke ovens at the Sault Ste. Marie, Ontario plant of Algoma Steel Corp., Ltd.

September 15

▲ Based on reports of companies having 93 per cent of capacity for the steel industry, the operating rate is scheduled at 101.8 per cent of capacity for the week beginning September 15. This is equivalent to 2,115,000 tons of steel ingots and castings compared with actual production of 2,093,000 tons one week ago.

▲ A corporation is reported being organized to set up a low blast furnace in Mexico.

September 16

▲ Canadian steel ingot output in July amounted to 285,332 net tons compared with 266,646 net tons for the same period in 1951.

▲ Rust Furnace Co. has been awarded a contract from U. S. Steel Co. for a continuous reheating furnace for its new bar and billet mill at Morrisville, Pa.

▲ The government owned Nicaro Nickel Plant in Cuba is now in full operation. This plant is privately operated by the Nickel Processing Co., owned jointly by American and Cuban capital.

September 17

▲ Robert C. Turner, new member of the President's Council of Economic Advisers, predicted that defense spending will climb to a quarterly rate of $14,000,000,000 by June 30, 1953.

September 18

▲ According to a joint survey by the Commerce Department and the SEC, plant and equipment expenditures by United States corporations totaling $14,300,000,000 have been scheduled for the last half of 1952.

▲ While negotiations were still in progress at Clearfield, Pa. for the purpose of settling walkout of 1400 employees of Harbison-Walker Refractories Co., 350 employees of the Hays Works voted to return to their jobs in defiance of their CIO union.

▲ According to the F. W. Dodge Corp., construction contracts awarded in the thirty-seven states east of the Rockies were $1,438,725,000 during August, 14 per cent higher than August 1951.

September 19

▲ The Labor Department reported that non-farm employment rose to 46,900,000 in August, an increase of 900,000 from July.

▲ In East St. Louis the price of zinc dropped ½¢ to 14¢ a lb.

September 20

▲ The Lake Superior Iron Ore Association reported that United States consumption of iron ore during August amounted to 6,914,633 gr tons, compared with 7,414,303 gr tons for the same period in 1951.

September 22

▲ The Defense Production Administration announced that manufacturers of civilian and defense-supporting products were allotted for the first quarter of 1953 60 per cent of the steel required for the current quarter.

▲ John L. Lewis, president of the United Mine Workers of America won direct wage and fringe boosts of approximately 32¢ an hr, thus averting a soft-coal strike of 170,000 northern miners.

▲ Based on reports of companies having 93 per cent of capacity for the steel industry, the operating rate is scheduled at 102.3 per cent of capacity for the week beginning September 22, 1952. This is equivalent to 2,125,000 tons of steel ingots and castings compared to actual production of 2,121,000 tons one week ago.

September 23

▲ Arthur D. Little, Inc., a large research organization, recommended to the Federal Reserve Bank of Boston that a smaller specialty steel mill should be built in New England, rather than the original 1,000,000 ton unit which would have cost $250,000,000. The smaller unit recommended is estimated to cost $14,000,000 and capacity of 140,000 tons.

▲ In East St. Louis the price of zinc was cut ½¢ to 13½¢ a lb.

September 26

▲ According to the AISC, August bookings of fabricated structural steel amounted to 257,773 tons, an increase of 16 per cent over July. Shipments during August were 225,013 tons. As of August 31 backlog of work ahead stands at 2,363,487 tons.

September 27

▲ According to the National Machine Tool Builders Association, machine tool shipments in 1952 will exceed $1,000,000,000. Monthly production is running at $100,000,000 in comparison with an average of $20,700,000 in 1949.

September 29

▲ Based on AISE reports from companies having 93 per cent the capacity of the steel industry, the operating rate is scheduled at 103.7 per cent of capacity for the week beginning September 29. This is equivalent to 2,153,000 tons of steel ingots and castings compared with actual production of 2,160,000 tons one week ago.

▲ United States Steel Co. changed policy for naming prices of tin mill products and in the future will announce twice a year instead of annually.

▲ At Inland Steel Co.'s Indiana Harbor works, East Chicago, the first steel was poured from the second of four new open-hearth furnaces today. The first furnace of the four was tapped September 10, and the other two are scheduled for completion before the end of the year. Plant capacity will be lifted to 4,500,000 tons annually when the four furnaces are complete.

September 30

▲ The RFC has agreed to purchase 6000 to 7000 tons of tin concentrates from the Bolivian government at a base price of $1.17½ a lb f.o.b., South American ports.

CALL Curry! FOR STEEL PLANT EQUIPMENT

If delayed delivery of new equipment is hampering your production schedule, consider good used equipment. We are in a position to offer with immediate delivery and large savings in cost, the steel mill equipment which you now need. At present we have available a wide range of mill machinery including large drive motors, hot strip mills, cold reduction mills, bar and rod mills, cranes, auxiliary equipment, and component parts for all types of mill operations.

Below you will find a partial list of available equipment. For a more complete accounting, write, phone or wire today for the "Curry List." Our service will eliminate your present "bottleneck" and increase your production.

38" CONTINUOUS HOT STRIP MILL, consisting of 2 Vertical Edgers, 3 2-High Roughing Stands, 4 4-High Finishing Stands, Flying Shear, Hot Runout Table, and electrical equipment.

12½" & 38" x 36" 4-HIGH REVERSING COLD REDUCTION STECKEL MILL, complete with 1800 H.P. Main Drive Motor, and all Auxiliary Equipment.

SCRAP BALLER. (1949 MODEL—NEVER USED) 24" diameter x 35" face roll, hydraulically retractible Mandrel, complete with Gear Reducer. Arranged for 10 H.P. Motor.

2½" & 20" x 7½" REVERSING COLD REDUCTION STECKEL MILL, complete with Recoiling Equipment, Main Drive Motor, Motor Generator Set, Controls, and Spare Parts.

30" DIAMETER x 77" U. E. & F. CO. AUTOMATIC RECOILER, complete with Brake and Gear Reducer, arranged for 250 H.P. Motor.

2000 H.P., G.E. SLIP RING MILL TYPE MOTOR, 3/60/2300v 237 RPM, complete with Liquid Slip Regulator and all controls necessary for mill type operation, including Filtered Air Cooling System.

Write for the Curry List today!

ALBERT Curry & CO., INC.

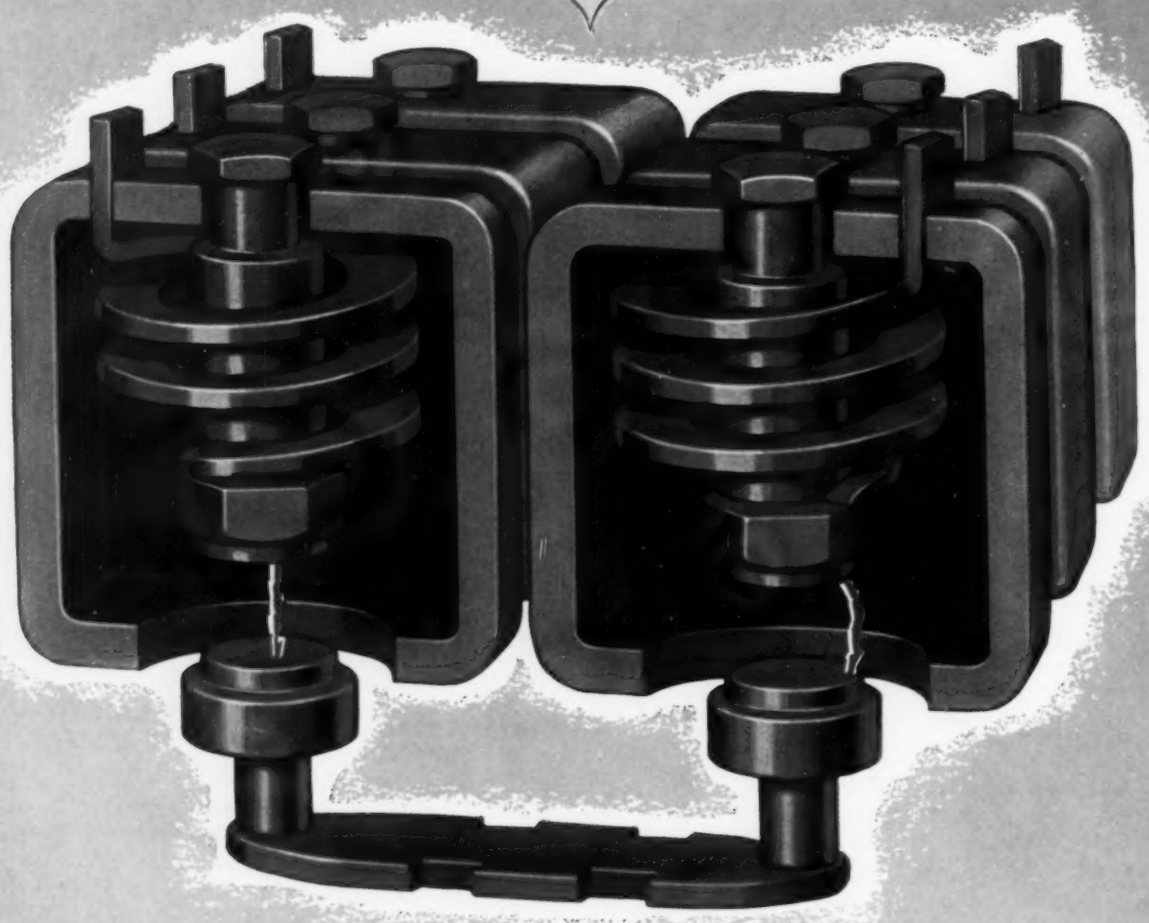
STEEL PLANT EQUIPMENT

Cable Address — Curmill Pittsburgh

940 OLIVER BUILDING • PHONE ATLANTIC 1-1370

CLARK TYPE "CY"

The starter with the NEW ARC QUENCHING PRINCIPLE



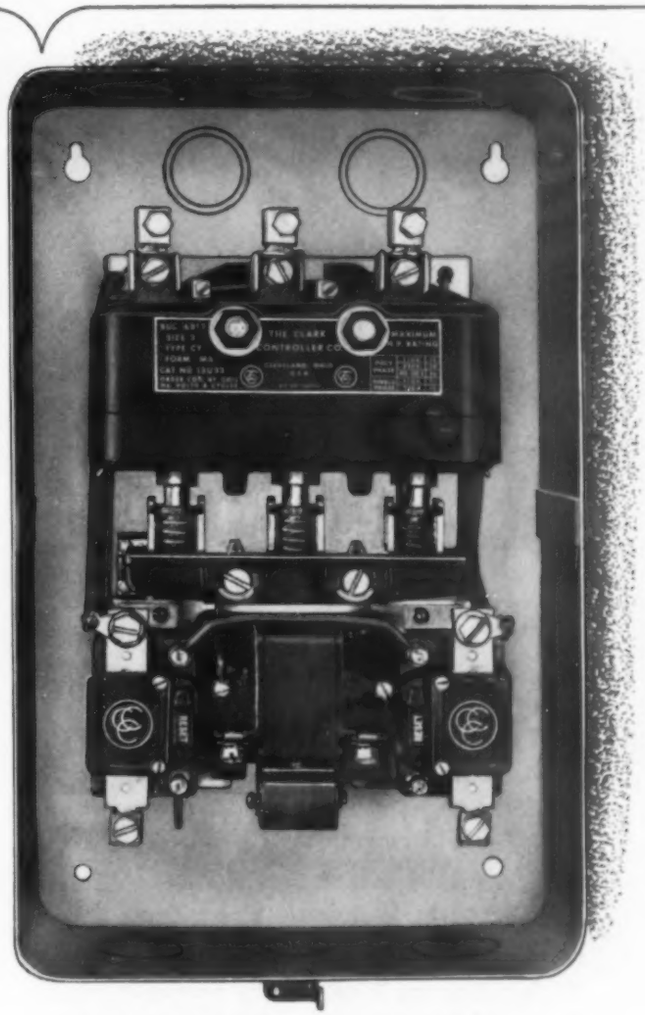
Here's what happens inside the steel arc shields of the new CLARK type "CY" AC Motor Starters, sizes 2 and 3. Combining strong multi-turn magnetic blow-outs and double-break contacts for the first time in this type of starter, the CLARK Type "CY" sets new standards for effective arc quenching and length of contact life . . . The effect of the magnetic field set up by the coil extinguishes the arc by either lengthening or confining it. At the same time the arc is forced to rotate, thus moving continually from a hot to a cold spot on the contact surfaces. The arc chamber is closed at the top, thus minimizing the chances of phase to phase failures by preventing accumulation of ionized gases between wiring terminals.

THE CLARK CONTROLLER CO.

AC MAGNETIC MOTOR STARTERS

Now Available in SIZE 3

Now you can get this revolutionary starter in sizes 0, 1, 2, *and 3*. The size 3 uses the same new principle of arc interruption—with magnetic blow-outs and twin-break contacts—which has proven so successful on size 2 . . . Here is a rugged AC Magnetic Starter that provides the extra protection and dependable operation of Mill-type, heavy-duty construction in a compact unit. In addition to the many built-in features which mean better performance, this starter is designed to reduce maintenance costs to an absolute minimum. Contact surfaces can be quickly inspected without tools. Contacts can be quickly replaced with a screw-driver and a wrench without removing starter from cabinet. All parts are accessible and removable from the front. Captive screws are used wherever possible to simplify reassembly.

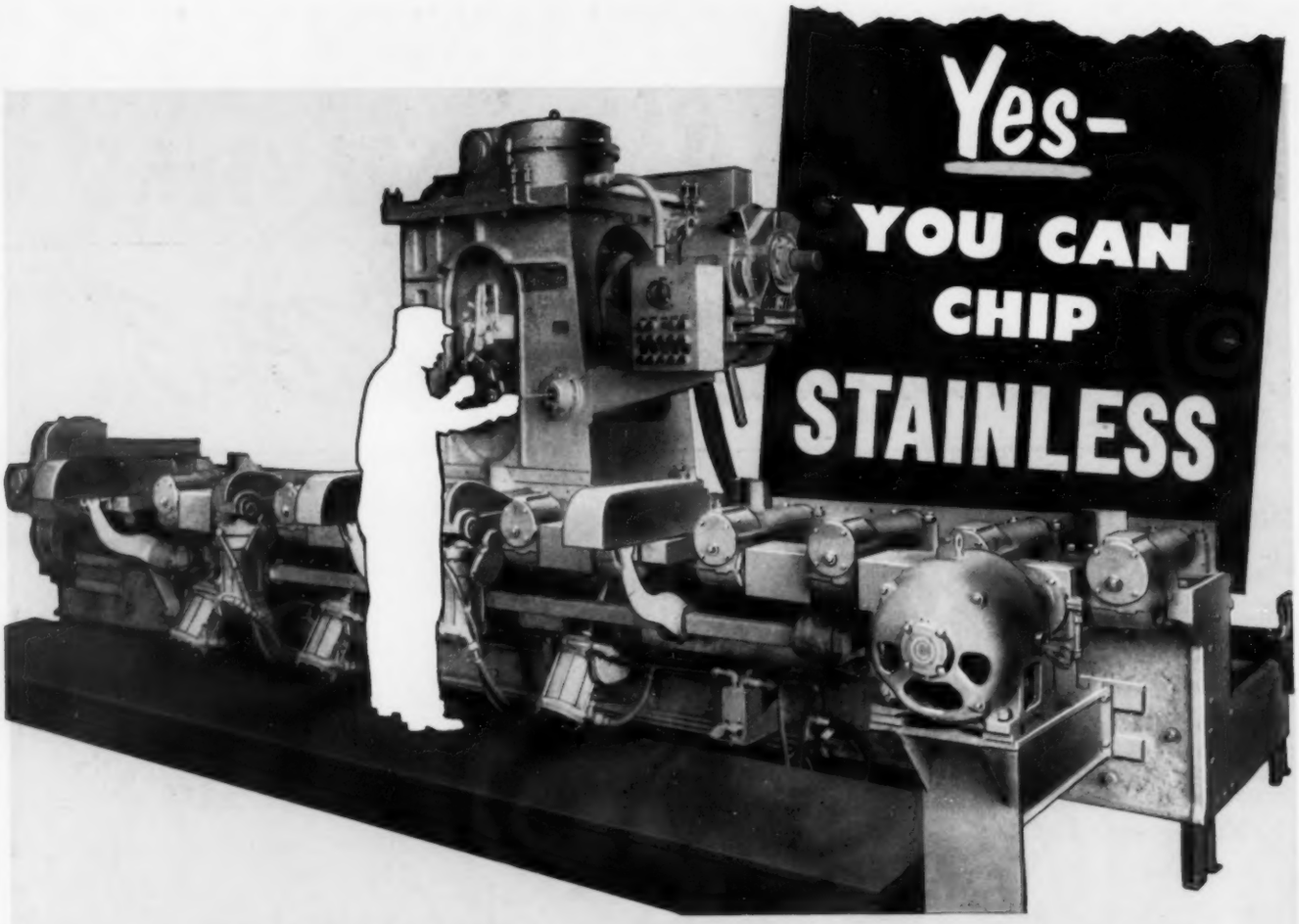


Clark Bulletin 6013 type "CY" AC Magnetic Starter, Size 3 with NEMA 1 cabinet cover removed. Note clean design, with plenty of wiring space.

CLARK Type "CY" AC Magnetic Starters are available in a wide variety of sizes, types of cabinets, and combinations of devices. Write for information.

1146 EAST 152nd ST.
CLEVELAND 10, OHIO

CLARK ENGINEERED ELECTRICAL CONTROL



. . . and the Bonnot Billeteer easily handles other "Tough Babies" too!

Bonnot Billeteering is producing surprising results with stainless steel. While we are not inferring that the "highest-brinell rated" stainless is being chipped, *exceptional results are being consistently obtained in brinell classifications under 400.*

And when it comes to toughness, let's consider 52100 high chrome, high tensile steel that's always a problem to condition:

With a Bonnot Billeteer the operator completely skinned (full surface removal) *in just 8 hours,* 8 sides of 7" square blooms, 10' long plus 5 sides of 14" square, 15' long . . . *2900 square inches per hour with Bonnot Billeteering.*

Yes, steels of the toughest varieties—with or without annealing treatment—are being successfully chipped by the Bonnot Billeteer every day, everywhere in the industry.

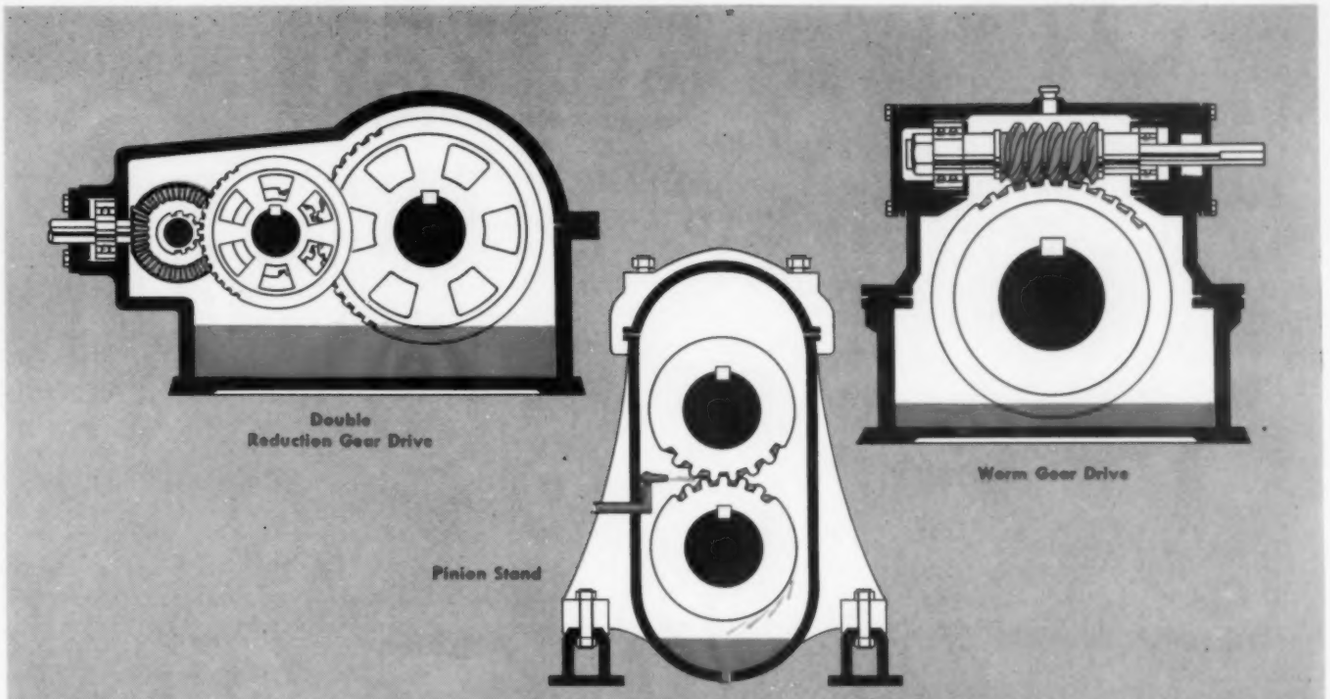
If you still are struggling with laborious, dangerous billet conditioning methods it will pay you to find out about Bonnot Billeteering. A real investigation of production being obtained may surprise you greatly. Never a better time to find out—and never an obligation.

Engineered For Improved Production

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO

Also Manufacturers of — SAWING • PULVERIZING AND MIXING EQUIPMENT • BILLET INSPECTION TABLES
CRUSHING • DUST PUG MILLS • SINTER PLANT PUG MILLS

NUMBER 5 OF A SERIES



How Gulf Periodic Consultation Service helps steel mills cut lubrication and maintenance costs

Gear lubrication problems, for example

You'll find that Gulf Sales and Staff Engineers do more than simply recommend the proper lubricant for every type of equipment in your mill. They offer expert help on every phase of lubrication.

On gear lubrication problems, for example, they are prepared to discuss the suitability of various gear lubricants and methods of application, the effects of lubricant contamination, and the causes of different types of tooth damage.

This is just one phase of the plan known as Gulf Periodic Consultation Service. For additional information, call in a Gulf Sales Engineer, or send the coupon below.

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719 Gulf Building, Pittsburgh 30, Pa.

Please send me, without obligation, a copy of the booklet "Gulf Periodic Consultation Service."

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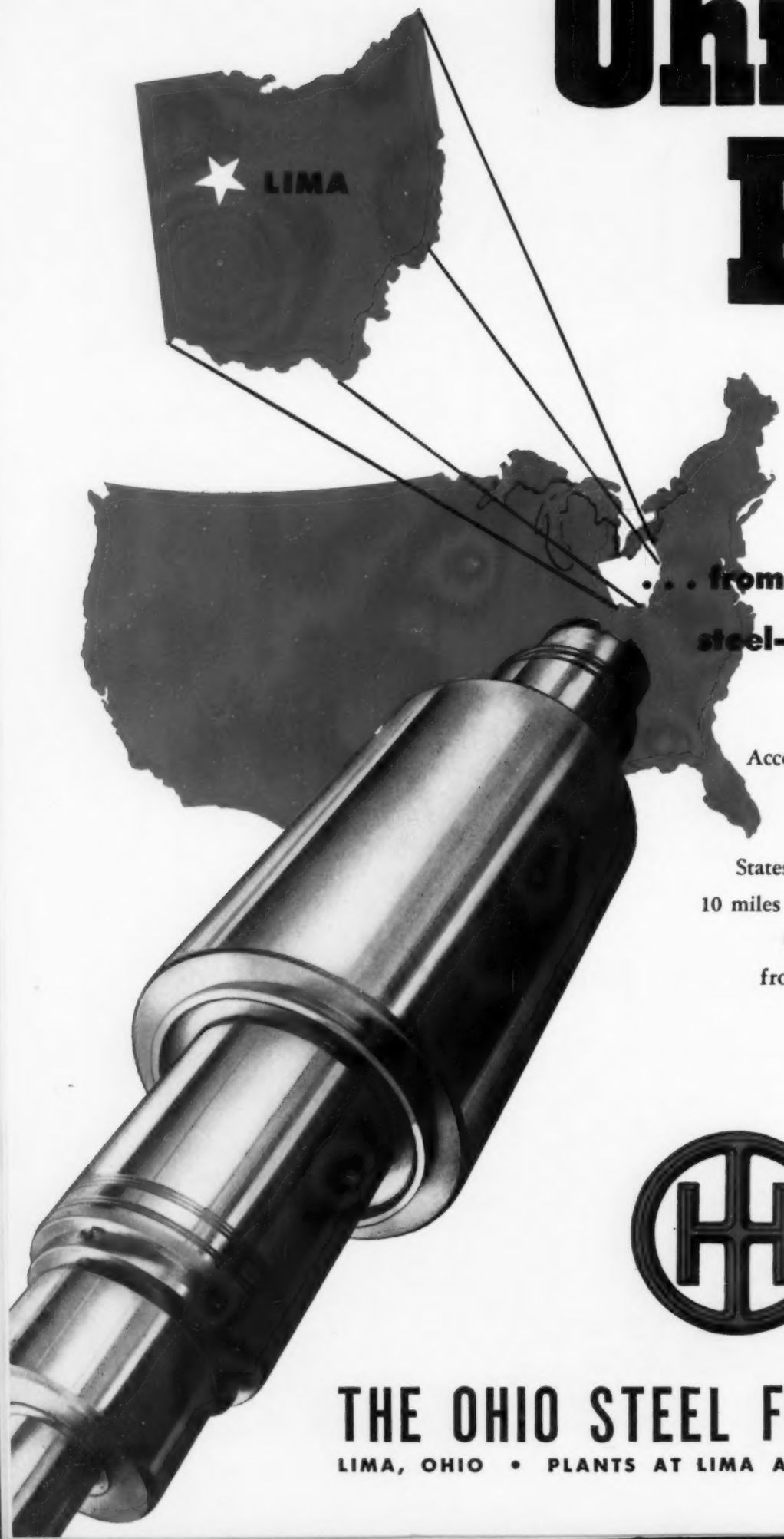
Ohio Rolls



. . . from the center of steel-making production

According to the American Iron and Steel Institute, the center of the United States steel-making capacity is just 10 miles North of Lima, at Beaverdam, Ohio. Your Ohio Rolls come from virtually the center of this capacity.

THE OHIO STEEL FOUNDRY CO.

LIMA, OHIO • PLANTS AT LIMA AND SPRINGFIELD, OHIO

Industry News...

NEW COKE OVENS REACH PEAK OPERATION AT PITTSBURGH COKE AND CHEMICAL CO.

▲ Pittsburgh Coke and Chemical Co. announced that its 35 new coke ovens reached full operation on October 7, thus marking the first result of a $20 million expansion at its Neville Island plant, five miles down the Ohio River from Pittsburgh, Pa.

The new battery of coke ovens is one of eight units involved in the expansion program, which will be completed early next year. Others are a new blast furnace, four new chemical plants, and additions to the cement plant and boiler plant.

According to R. M. Marshall, president, the added facilities will strengthen Pittsburgh Coke and Chemical's position as a producer of chemicals for varied national markets. The company will also increase its output of basic products for regional markets: coke, pig iron, cement.

In evaluating the expansion, Mr. Marshall said:

"The present expansion represents the company's most important step forward to date. We have for some years placed increasing emphasis on the production of chemicals, not merely in their crude form, but suitable for marketing to end-use industries. This has been reflected in the company's sales volume during recent years. Our total sales of chemicals has grown from less than $4 million in 1947 to more than $18 million in 1951, an increase of some 390 per cent as against a gain of 125 per cent in the sales of our other products."

The new ovens, which cost $6 million, will give the firm a total of 140 by-product ovens. The company has been turning out 600,000 tons of furnace coke and 75,000 tons of foundry coke yearly, to which the new ovens will add about 33 per cent in capacity. The company is the only major by-product oven source of foundry coke in the Pittsburgh area.

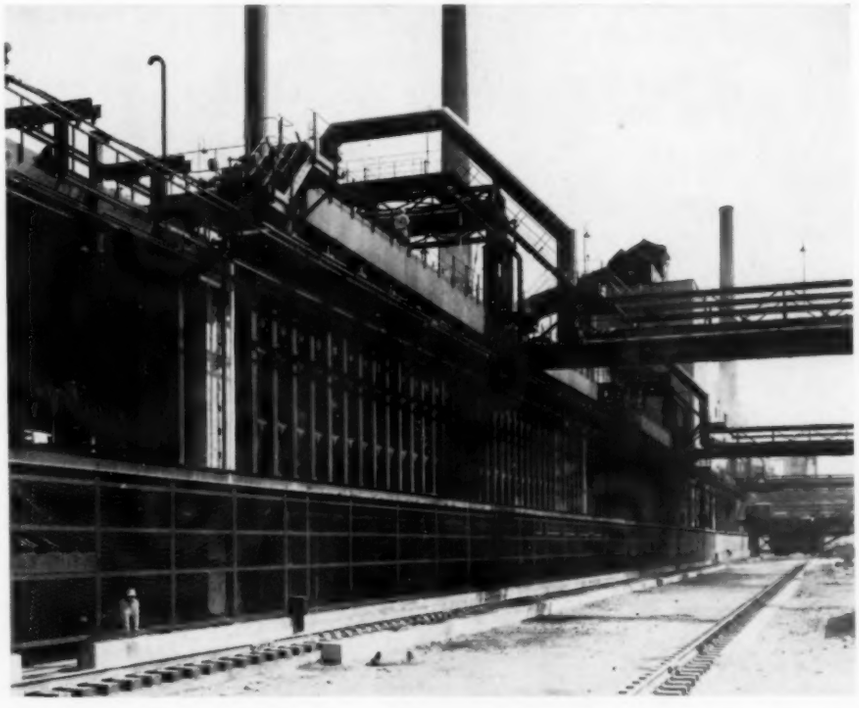
Much of the coke output moves into the company's blast furnaces, of which there will soon be three. The gases collected from the coking process are the source of many chemicals used by industry in producing thousands of articles for everyday use, from toys to powerful drugs and insecticides.

Some $3,300,000 of the present expansion budget is allocated to additional chemical facilities, but this is on top of more than $7 million spent in the past four years for new chemical plants. Together with capital expenditures during the years 1947-1951, the company has committed $34 million to plant expansion and improvements since the war. A sizable portion of this has been for additions to the spreading network of chemical plants, of which there will soon be 19. The production of chemicals will also be benefited by the enlarged coking operations.

The company's new fine chemical plant, which should be ready by the end of the year, is expected to develop additional end-use markets through the production of dyes and other fine chemicals such as pharmaceutical intermediates.

Most costly unit in the expansion is an $8 million blast furnace, scheduled to start making iron in November. The new furnace will add 300,000 net tons of iron to the company's present capacity of 470,000 tons a year. Pittsburgh Coke and Chemical is the only major merchant producer of pig iron in the Pittsburgh area.

This view shows the "pusher" side of the ovens, with the newest battery at the left. The overhead pipes convey the gases and vapors liberated in the coking process, to the recovery and chemical refining plants.



WAGNER ELECTRIC BUYS NEW PROPERTY

▲ Wagner Electric Corp., St. Louis, Mo., recently purchased from Fulton Iron Works Co. a portion of their property adjoining the Wagner main plant. This property, which was no longer in use by the Fulton company, consists of about three acres of land with four buildings having a combined floor area of more than 100,000 sq ft. It will be used to increase the Wagner company's transformer manufacturing capacity.

The newly acquired buildings will be completely renovated and modernized, and the manufacture of large distribution, small power, and all unit

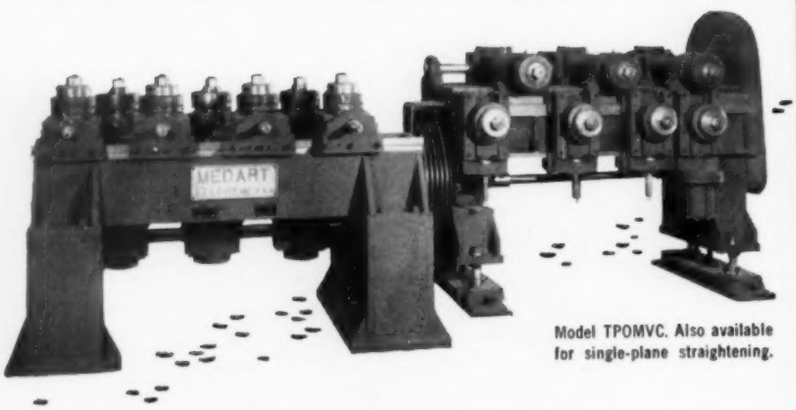
Versatile! Variable Centers!

Faster Straightening Of An Extreme Range Of Shapes On This New Machine

MEDART

Two-Plane–Overhung Roll–Variable Center

SHAPE STRAIGHTENER



Model TPOMVC. Also available for single-plane straightening.

- Combines the fast, simple setup advantage of an overhung roll straightener, with exceptionally versatile control of bending stresses possible only in a movable-roll center type of machine.
- Variable center roll housings permit adjustment of bending spans for handling an extreme variety of shapes and sizes. This feature prevents overloading of bearings and assures uncommon accuracy.
- Bottom rolls can be moved directly under top rolls for cross-rolling or reforming cross sections of distorted extruded or other shapes simultaneous with straightening action.
- Top and bottom rolls, when set in opposing pairs, act as additional pinch-feed rolls for extra traction required for difficult-to-straighten shapes.
- Rolls are quickly and easily changed by removing locknut on end of each shaft.
- Rolls are of Medart Smavroc alloy steel hardened and ground to shape ... All gears operate in oil within enclosed housings ... Pinch-feed rolls at end are air-operated. Timken bearings throughout.

Write For Complete Details

THE MEDART COMPANY 3533 DE KALB STREET ST. LOUIS 18, MISSOURI

substation transformers will be concentrated in this section.

Production of large power transformers will be centralized in the main transformer shop, which will be equipped with heavier cranes, new high voltage testing apparatus, additional annealing furnaces and otherwise converted to make possible the manufacture of transformers weighing up to twice as much as the largest units that can be built with present facilities.

It is estimated that completion of the planned expansion and conversion program will require at least one year, and that the cost will exceed a million dollars. When this added capacity is available, the Wagner company will be in an excellent position to supply the increasing demand for all types and ratings of transformers.

SPECIAL FURNACE DESIGNED FOR FAIRLESS WORKS

▲ A continuous reheating furnace to serve United States Steel Co.'s new bar and billet mill at Morrisville, Pa., will be the widest, and highest capacity furnace of its type ever built, according to Rust Furnace Co., the designer-constructor.

The new furnace will have a capacity of 150 tons per hour. Its design calls for an effective heating length of 60 ft, and an inside width of 43 ft —a width thought to be greater than any existing furnace of the type.

Designed with a sloping hearth, the triple-zone furnace will have a metallic recuperator and will be equipped to burn a combination of coke oven gas and fuel oil.

Rust is also constructing four slab heating furnaces for the U. S. Steel Co.'s new strip mill at the Fairless Works.

KOPPERS WILL CONSTRUCT COKE OVENS FOR ALGOMA

▲ Algoma Steel Corp., Ltd., Sault Ste. Marie, Ontario, has awarded Koppers Co., Inc., a contract to design and build a new battery of 57 chemical-recovery coke ovens. The new battery will be of the Koppers-Becker design and that construction is expected to be completed in mid-1953.

The new ovens will each take a 17½-ton charge of coal and will operate on a 17-hour coking cycle.

Koppers also will construct additional by-product equipment and a coke handling and screening system for Algoma.

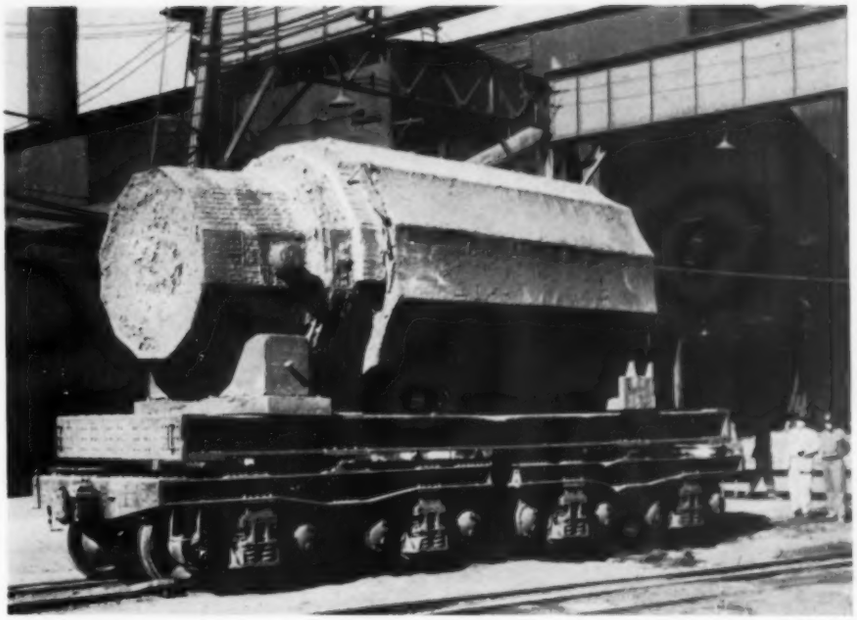
LEEDS & NORTHRUP CO. MOVES DISTRICT OFFICE

▲ The Philadelphia, Pa., district sales office of Leeds & Northrup Co., manufacturer of electrical measuring instruments, automatic controls, and heat-treating furnaces, has moved from 4901 Stenton Ave. to new and larger quarters at 444 North 16th St.

The greater space provided in the new offices affords better facilities for supplying engineering information and service to manufacturers, researchers, and educational institutions in Pennsylvania west to Altoona and the coastal states from New Jersey through North Carolina.

The company's advertising department and training school will occupy

CAST 672,000 POUND INGOT



What is said to be one of the largest ingots ever cast in the United States was forged by Midvale Co. in its Nicetown, Pa., plant. When stripped from its cast iron mold in the Midvale open hearth department, it weighed 672,000 lb. It was transported immediately by rail on a specially built 16 wheel truck to a press plant where it is being forged into a single piece, ready for machining.

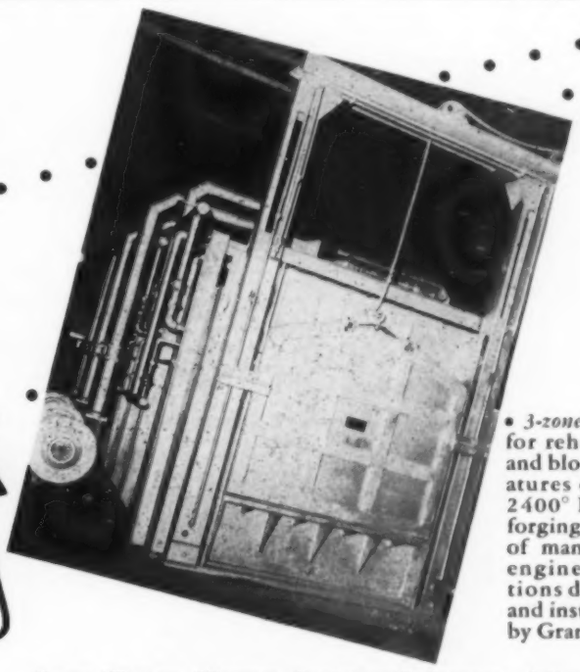
Meet today's increased tonnage demands with...

Custom Engineered

FURNACES

by

Grant Watson



• *3-zone reheat furnace* for reheating billits and blooms to temperatures of 2250° F to 2400° F previous to forging or rolling. One of many individually engineered installations designed, built and installed complete by Grant Watson.

Designers of individually engineered heating and heat treating furnaces, both gas and oil fired, for reheating slabs, billets, rods, bars and blooms; forging; soaking pits; annealing and normalizing; stress relief; and other industrial heating applications.

Grant Watson "Custom Engineered" furnaces deliver maximum heating efficiency, uniform product quality, positive temperature control plus the versatility and flexibility that pays off in increased tonnage and economical operation. Regular COST-FREE SERVICE after installation reduces maintenance costs, assures trouble-free performance day-in and day-out.

Write, wire or call for instant service on custom engineered furnaces to meet your requirements and specifications

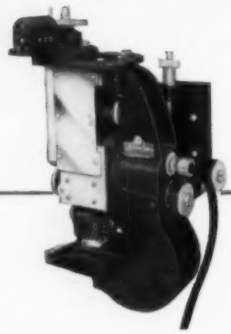
GRANT WATSON CONSTRUCTION COMPANY • 1398 So. Santa Fe Drive, Denver, Colorado

INCREASE
OUTPUT

IMPROVE
QUALITY
WITH

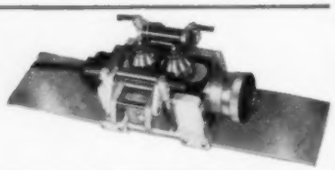
PRATT & WHITNEY
Continuous Gages

THE MOST COMPLETE LINE OF GAGES FOR CONTROLLING QUALITY OF METALLIC AND NON-METALLIC STRIP MATERIAL



MODEL D, *Electrolimit* CONTINUOUS GAGE

Model D Electrolimit Continuous Gage continuously and accurately indicates any thickness variation down to .0001" in steel or other metallic strip. Faster production with extremely high standards of uniformity are maintained on rolling mills and inspection lines.



MODEL B, "MAGNETIC" WIDTH GAGE

Model B "Magnetic" Width Gage is used to check strip widths up to 2" and also for measuring wire and many other round or flat materials continuously and dependably.

BETA RAY GAGE

The Pratt & Whitney Beta Ray Gage is entirely non-contacting and extremely accurate. Practically all substances — including many that cannot be gaged continuously by any other method — are dependably measured with the Beta Ray Gage.

P&W CONTINUOUS GAGES FOR OTHER APPLICATIONS:

Foil Gage, Model 10A "Magnetic" Gage, Model R Gage, and Pressure Block Gage for continuous mills.

AND NOW — adding even greater scope, utility and dependability to continuous gaging — Pratt & Whitney offers you a complete line of AUTOMATIC CONTROL UNITS. Be sure to read, on the facing page, about this important advancement in quality control; send today for complete information.

Send for Circular No. 553

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DIVISION NILES-BEMENT-POND COMPANY
WEST HARTFORD 1, CONNECTICUT, U. S. A.

First Choice for Accuracy

BRANCH OFFICES AND STOCK . . . BIRMINGHAM* . BOSTON . CHICAGO
CINCINNATI . CLEVELAND . DALLAS (The Stanco Co.) . DETROIT . LOS ANGELES
HOUSTON (The Stanco Co.) . NEW YORK . PHILADELPHIA . PITTSBURGH
ROCHESTER . SAN FRANCISCO . ST. LOUIS . EXPORT DEPT., WEST HARTFORD

MACHINE TOOLS • CUTTING TOOLS • GAGES

*OFFICE ONLY

the remaining space at the new 5-story building address. A large adjoining warehouse is also being occupied by the firm. Areas thus vacated in the main plant on Stenton Ave. will be available to meet constantly increasing demands of manufacturing departments.

ORE HANDLING FACILITIES EXPANDED AT BALTIMORE

▲Ore unloading facilities of the Canton Railroad in the Baltimore, Md., harbor are being expanded and modernized to speed up the transfer of incoming ore from ships to railroad cars.

The plant when completed will have a maximum rated capacity of 3,000 tons an hour, about double the present tonnage. It will be equipped with a giant conveyor system which can speed the ore from ship to shore at the rate of 50 cars (60 tons to a car) an hour. The actual weighing capacity at the track bin can be increased beyond this rate in emergencies.

The expansion program was undertaken in anticipation of increased imports of iron, manganese, chrome and other ores coming in from new developments in Labrador, Venezuela, Brazil and Liberia, and at the same time to handle larger imports from older producing sources in Sweden, Yugoslavia, Turkey, Africa and the Far East. Ore imports are increasing due to depletion of reserves in the United States.

The Canton ore pier is located on the north bank of the Patapsco River. A 90-ft wide, finger type pier, it extends 1253 ft south into the river. The ship berths on the west side are dredged to a depth of 35 ft. Four standard gauge railroad tracks, each with a capacity of 35 hopper cars, extend the full length of the pier. The Canton Railroad moves the loaded ore cars to interchange tracks where they are picked up by three trunk line carriers serving the port — the Baltimore and Ohio, the Pennsylvania and the Western Maryland.

Before the modernization program was undertaken, two cranes on the pier scooped the ore up out of the ships and discharged it directly into railroad cars.

When the new conveyor system goes into operation, the Canton facil-

ity will be the only one on the East Coast which will have both a crane system to unload directly to cars and a conveyor system which passes through a weighing station to cars. Not only will the installation be able to handle the unloading of large ore boats at great speed but it will continue to handle split shipments consisting of several types of ore in a single vessel.

The conveyor system, designed and installed by Robins Engineers Division of Hewitt-Robins, Inc., features two 48-in. wide belt conveyors totalling more than 1600 ft in length. The main belt running along the docks will be fed for the time being by two ship unloading cranes. Each one is designed to handle 1,000 tons an hour. A third ship unloading crane of at least 1,000 tons capacity is scheduled to be placed in operation in the second quarter of 1953. Thus when all three unloading towers become operative, the conveyor will be able to move 3,000 tons an hour.

From the main belt, the ore will be transferred to a second belt which carries it up a 16-degree incline to a weight station 100 ft high. The uphill belt operates at a speed of 615 fpm compared with 545 fpm for the longer belt. Atop the weigh station is a large balancing hopper which receives the ore and feeds it into four smaller weigh hoppers, each located over a railroad track. The weigh hoppers, scales and weight recorders are electrically interlocked in a fixed cycle to regulate the flow of the ore into the cars.

In addition to the conveyor system now being installed, and the additional crane to be built later, the Canton Railroad is building a new 500 car supporting yard for the ore pier. This project involves over five miles of new track. An apron 12 ft wide has been added to the east side of the pier to support the new main conveyor. The apron is supported by a combination of wood and concrete piles.

PLANS INSTALLATION OF AIRCRAFT SHEET MILL

▲ The nation's first large mill specifically designed for the rolling of tapered aircraft skin sheets is to be installed by the Aluminum Co. of America at its Davenport, Iowa, plant. The unique installation will

CONTROL
WITHOUT HUMAN ERROR
for continuous production
PRATT & WHITNEY
Automatic CONTROL UNITS

AUTOMATIC MILL GAGE CONTROL, MODEL C — For Automatic Screw Down Control

AUTOMATIC SIZE CONTROL, MODEL D — For Automatic Diameter Control of Extruded Covered Wire

TOTALIZER — A Complete Record to Assist Effective Production Planning and Checking

LIGHT SIGNAL CONTROL — A Dependable, Automatic, Off-Gage Warning Signal

Pratt & Whitney Automatic Control Units are designed for use in conjunction with Pratt & Whitney and other suitable Continuous Gages. They assure superior product uniformity by practically eliminating the element of human error. Preset to any desired tolerance, they react instantly and automatically when plus or minus limits are exceeded. Electric impulses operate the mill control mechanism to provide exact thickness correction without operator attention; and actuate visible or audible warning signals. If desired, P&W RECORDING UNITS will provide a complete record of the thickness of material being rolled.

Pratt & Whitney Automatic Control Units are made in a variety of types and models, which are successfully applied to a wide range of rolling and other continuous production processes. Pratt & Whitney Gage Engineers are at your service to study your requirements and recommend the Control Units best suited to your needs. Write on your Company letterhead to the Pratt & Whitney Branch Office nearest you or direct to West Hartford, Conn.

PRATT & WHITNEY
DIVISION NILES-BEMENT-POND COMPANY
WEST HARTFORD 1, CONNECTICUT, U. S. A.

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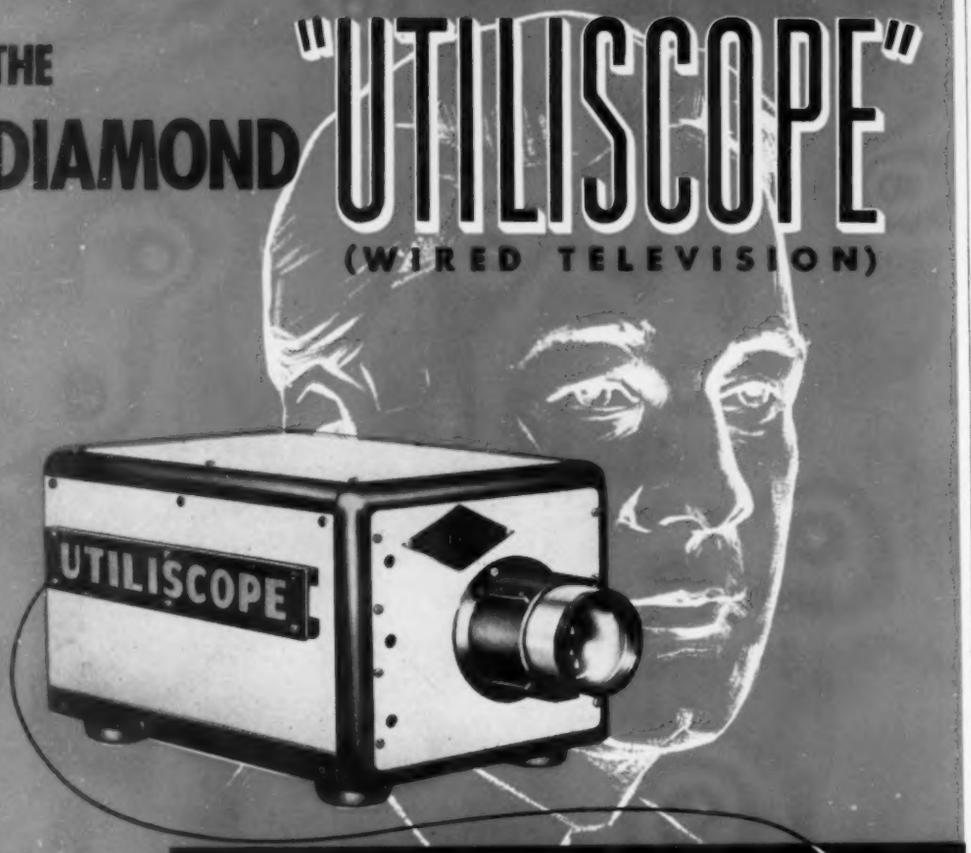
MACHINE TOOLS • CUTTING TOOLS • GAGES

THE DIAMOND "UTILISCOPE"
(WIRED TELEVISION)



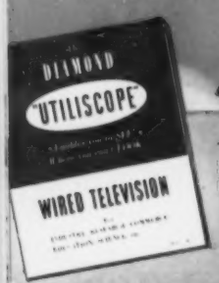
An employee who...

Requires no pay check
Never makes a mistake
Works 24 hours a day
Never takes a vacation

Many industrial operations that must be watched continuously and formerly required the individual attention of a man, are now being done without the man . . . by using a Diamond "Utiliscope" (Wired Television). The camera takes the place of the man . . . the monitor or receiver brings an exact picture of what is happening (as it happens) to a remote central control point or wherever else desired.

The "Utiliscope" is surprisingly low in cost. Its image is always clear and stable—it cannot transmit an incorrect image. It is on the job 24 hours a day, day in and day out, with practically no attention. The "Utiliscope" has no human limitations.

Let us tell you how the "Utiliscope" is now saving manpower, improving product quality, increasing production or preventing accidents. There probably is an application you can use to advantage. Write for Bulletin.



WRITE FOR BULLETIN 1025E

TYPICAL USES—Checking remote gauge readings • Watching flow of molten steel • Viewing nuclear research • Observing conditions inside furnaces • Coordinating materials flow on conveyors. • "Utiliscope" (Reg. U.S. Pat. Office)

4589

DIAMOND POWER SPECIALTY CORP.
FIRST IN INDUSTRIAL TELEVISION
LANCASTER, OHIO • OFFICES IN 39 PRINCIPAL CITIES
Diamond Specialty Limited—Windsor, Ontario
Since 1903, Diamond has Manufactured Quality Equipment For Industry

produce extra-wide tapered sheets and result in reduced assembly time for wing sections on tomorrow's airplanes.

Capable of a maximum delivery speed of 120 fpm, the 144-in., 4-high reversing mill will be driven by a 3000-hp, d-c motor, supplied by the General Electric Co.

Wide speed ranges from 80 rpm to as low as 5 rpm will be required of the big G-E motor, since mill speed must be maintained in ratio to the speed of motor-driven screws which adjust roll separation to produce desired thickness in the plate.

Designed, installed, and operated by Alcoa under Air Force contract, the new mill will turn out skin plates up to 10 ft wide and more than 33 ft long. Present limits are slightly more than 5½ ft and 25 ft, respectively.

Thickness of the finished product will vary from 1.5 in. down to .064 in., while the maximum taper ratio will be 4.5 to 1 with a maximum tapered rate of 0.050 in. per foot of sheet.

Besides the main drive motor, General Electric will furnish a 2500-kw synchronous motor-generator set, 2300-volt switchgear, complete controls, ventilating equipment, and a 5000-kva transformer.

HARNISCHFEGER CELEBRATES NEW SALES UNIT OPENING

▲ Official opening of their large new sales office, warehouse and service station in Birmingham, Ala., was celebrated October 11 by the Harnischfeger Corp., Milwaukee, Wisc., with an open house and barbeque.

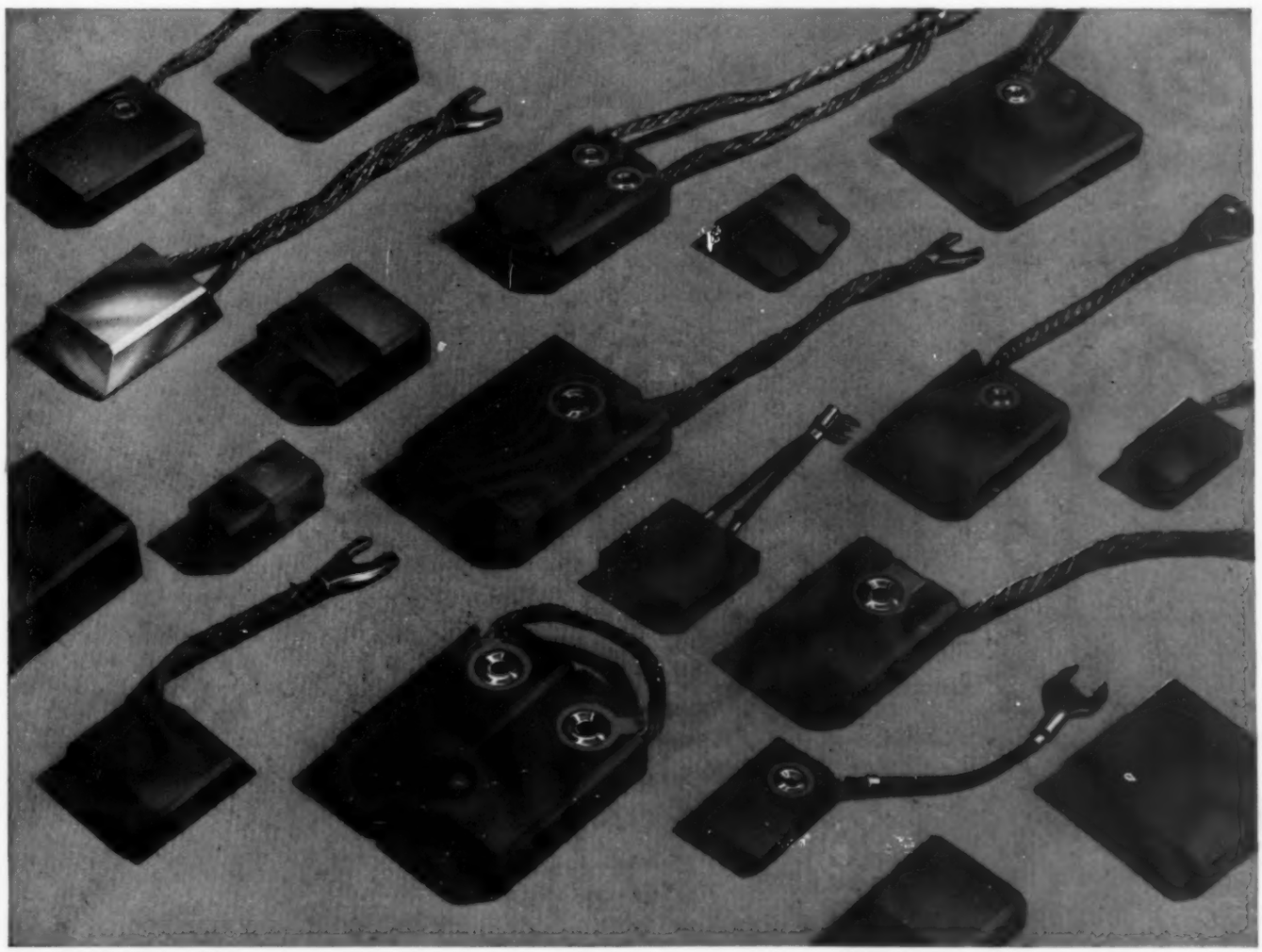
This opening also announces the consolidation in Birmingham of all territory formerly served by P&H offices in Memphis, Tenn. and Jacksonville, Fla. Harnischfeger will retain sales representation in these two cities, but major functions will be centralized in the Alabama city to provide customers in Southeastern states, as well as Louisiana and Arkansas, with larger warehousing facilities and more extensive service accommodations.

Moving up from his position as Memphis district manager to take charge of the new plant and territory is Ray M. Calkins, a veteran of 28 years of service with Harnischfeger. Mr. Calkins has been director of Memphis area activities since 1945

BUY USG® BRUSHES

Try USG Brushes. They will solve those tough application problems for you. • Complete manufacturing facilities, plus continuous research and engineering make USG Brushes and Contacts the best you can use on all rotating electrical equipment. • USG BRUSHES can do a *better* job for you . . . Let us arrange a performance test to prove it.

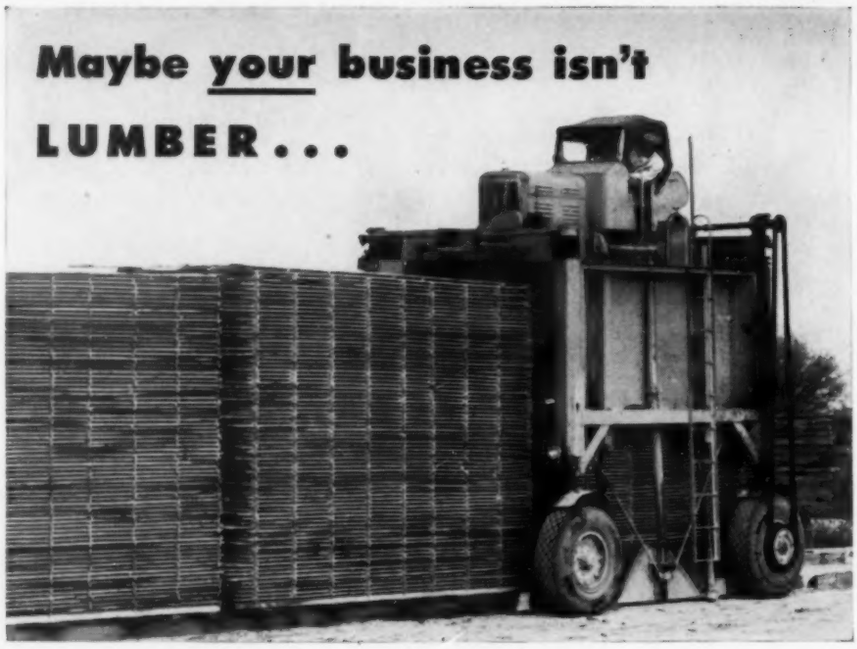
Write today for 40-page catalog giving complete information on standard USG grades.

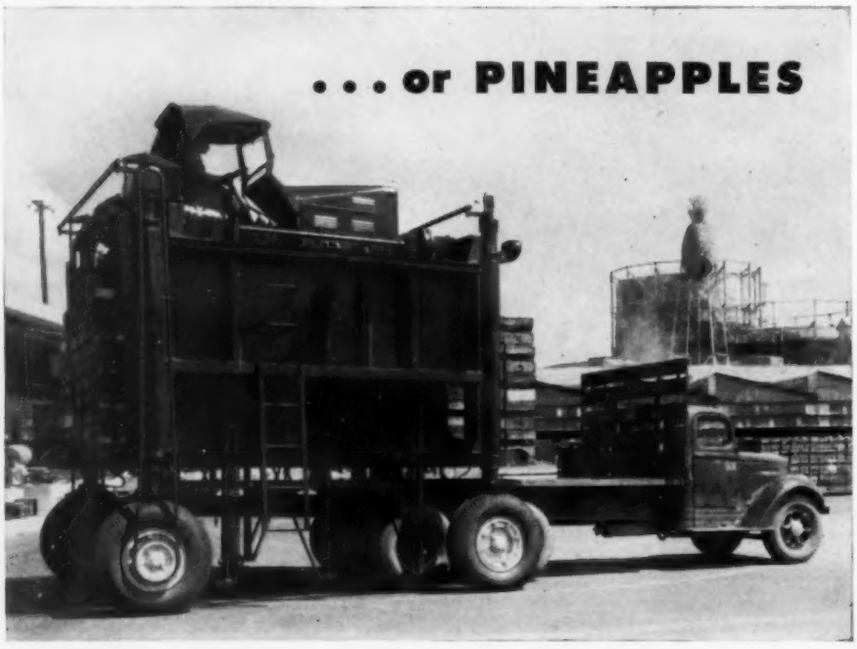


90-B

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN





BUT. . . just imagine the savings you could make, the problems you could solve by handling your materials with ROSS Straddle Carriers, the most flexible and most adaptable mass material handling method known!

ROSS engineers will be glad to work with your materials handling men in exploring the possibilities of ROSS Straddle Carriers for your operations . . . there's no obligation.

Send for details on ROSS Straddle Carriers . . . 10,000 lb., 20,000 lb., 35,000 and 45,000 lb. capacities .

Rely On ROSS

THE ROSS CARRIER COMPANY

Direct Factory Branches and Distributors throughout the world.

400 Miller St., Benton Harbor, Michigan, USA

and formerly served in P&H's engineering, specifications and stores departments before becoming assistant sales manager of the company's small excavator division in 1938.

NEW LAYOUT METHOD PATENT ASSIGNED TO OAKMONT PLANT

▲ U. S. and Canadian patents have been granted to Homer H. Deasy of Oakmont, Pa., covering a new plant layout method using three-dimensional models as a planning medium, coupled with a photo film two-dimensional templet.

The film templet, used in conjunction with a film grid sheet, make it possible to secure "Ozalid" or blueprints directly from the three-dimensional layout. All layout and lettering time is eliminated and prints are standardized by this patented method of plant layout.

The patents have been assigned to "Visual" Planning Equipment Co., Inc., of Oakmont, Pa.

MEEHANITE LICENSES FIRM TO MAKE CASTINGS

▲ Meehanite Metal Corp., New Rochelle, N. Y., announces that it has concluded an agreement with Crofts Engineers, Ltd., for the exclusive right in the United States, Canada, Mexico, Central, South America and other countries to enter into agreement with the industries for use of the process and installation of the necessary equipment.

The process is simple, completely effective and results in improved economy of cupola operation which has been proven by several units already in operation. The unique features of this invention consist of feeding turnings, borings, etc. into a chute placed at cupola platform level and forcibly assisting their introduction through the refractory wall of the cupola just above the melting zone.

This perfected novel process and device for using metal borings operates with negligible metal loss and completely eliminates the cost of any briquetting process. It represents a most important contribution to the present impetus for improved economy in manufacturing costs so necessary in competitive markets.

THIS DEVICE HAS ROLL CURVE UNDER COMPLETE CONTROL

THIS DEVICE is the "brain" which guides the grinding wheel of a Farrel roll grinder along a perfectly graduated, mathematically accurate curve. It makes sure that crowned or concaved rolls are ground with both halves perfectly symmetrical.

If you are having trouble in obtaining a truly accurate contour on your rolls, a Farrel grinder will provide the solution to your problems.

The automatic crowning and concaving device, which is built into the machine, is of the adjustable, single eccentric type. Designed for ease and simplicity of setting, it assures exact synchronism between wheel carriage and wheel. The same setting invariably produces exactly the same curvature, permitting uniform and easily controlled accuracy of contour in all rolls.

Farrel roll grinders are available in two types — type HD shown here, and type TT with traveling work table. Bulletins giving complete specifications of either type will be sent promptly on request.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia & Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Chicago, Los Angeles, Houston

FB-775

Farrel-Birmingham®

FEATURING:

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- GREATEST DURABILITY
- LOWEST MAINTENANCE

You can save REAL money on the operation of electric trucks. Ready-Power DIESEL-Electric drive is the answer. Actual tests prove savings of 40% to 70% in operation and maintenance. Rugged DIESEL design provides *more* work per gallon of fuel, *longer* life span and *less* maintenance. And Ready-Power DIESEL-Electric Units provide the most efficient, most constant, most economical power source for electric industrial trucks.

Remember...Your Truck Is No Better Than Its Power!

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The READY-POWER Co.

3836 Grand River Ave., Detroit 8, Michigan

Manufacturers of Gas and Diesel Engine-Driven Generators and Air Conditioning Units; Gas and Diesel-Electric Power Units for Industrial Trucks

ZINC MEETING FEATURES PLANT INSPECTION TRIP

▲ The fall meeting of The Galvanizers Committee, sponsored by American Zinc Institute, will be held at the Bismarck Hotel, Chicago, Ill., on Thursday, Friday and Saturday, November 20-21-22.

According to J. T. Mayhew, Weirton Steel Co., chairman of the governing board, the highlight of the meeting will be an all day inspection trip of the Inland Steel Co., Indiana Harbor, Ind., plant on Friday.

R. J. Stoker, U. S. Steel Co., and his program committee have announced that at the closed sessions on Thursday morning and Saturday morning, subjects of interest to operating and technical men will be discussed. On Thursday afternoon, an open meeting has been scheduled when qualified speakers will discuss several angles of the industry's fabricating and marketing problems.

Before the close of the meeting, successors will be named to fill the places of the two retiring members of the governing board which now consists of J. T. Mayhew, Weirton Steel Co., chairman; F. F. Aloi, Bethlehem Steel Co.; N. E. Cook, Wheeling Steel Corp.; B. P. Finkbone, Armco Steel Corp.; C. H. Fitzwilson, Columbia-Geneva Steel Div.; R. S. Gentz, Inland Steel Co.; F. G. White, Granite City Steel Co.

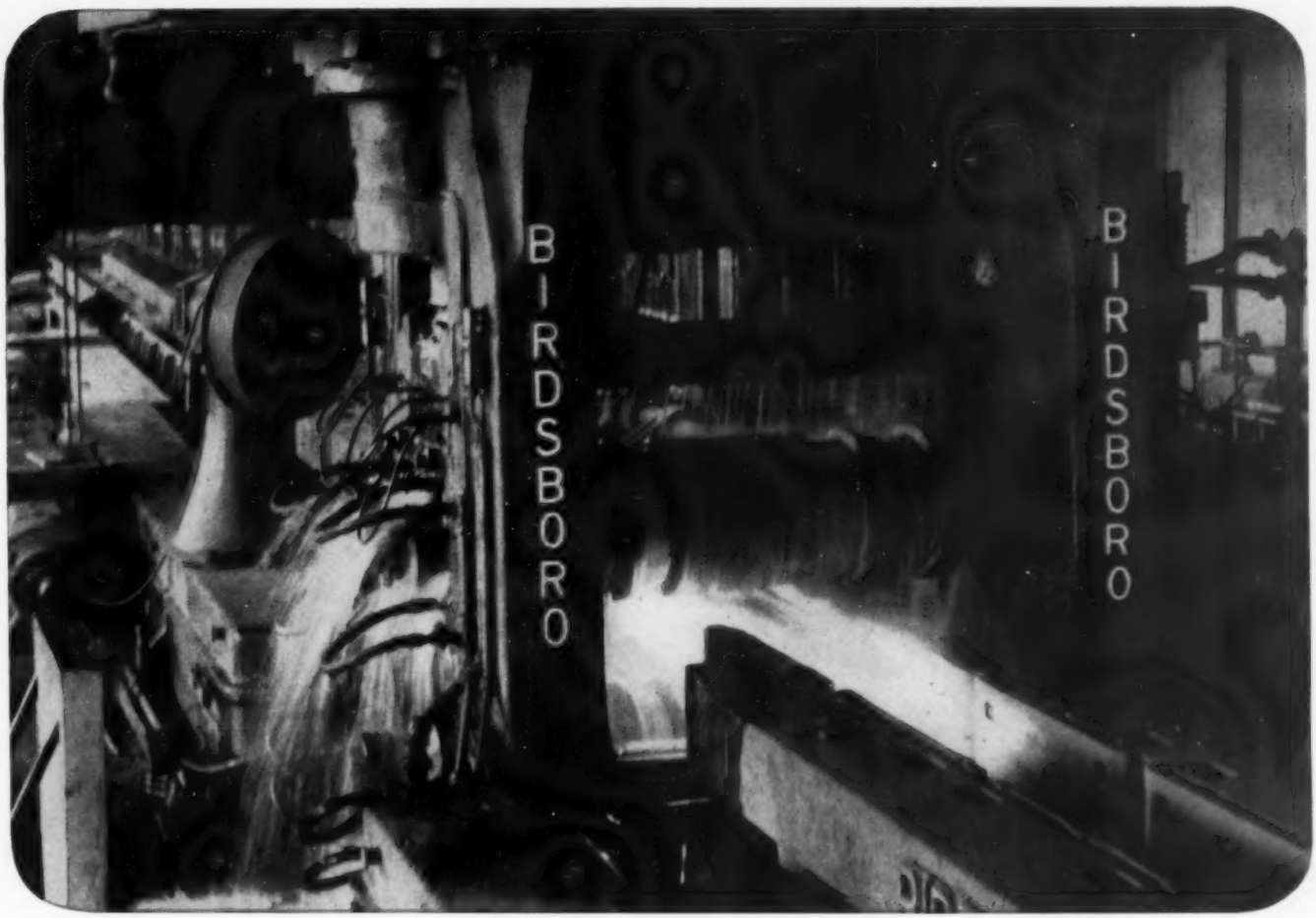
EXPANSION PROJECT ORDER AWARDED TO WESTINGHOUSE

▲ Westinghouse Electric Corp. has received an order of more than half a million dollars from Youngstown Sheet and Tube Co. at Indiana Harbor, Ind. Westinghouse will supply all electrical equipment for a continuous pickling line and for two shearing lines.

The new order brings the total amount of Westinghouse electrical equipment furnished for the Indiana Harbor expansion project to nearly $3,000,000.

Wean Engineering Co. of Warren, Ohio, will supply the continuous pickling line, and Aetna Standard Engineering Co. of Pittsburgh, Pa., will furnish the two shearing lines.

BIRDSBORO BLOOMING MILLS



For small two-high reversing mills for the production of semi-finished products, see Birdsboro, designers and builders of every such unit installed in the United States and Canada in the last decade

BIRDSBORO
STEEL FOUNDRY & MACHINE CO.
Birdsboro, Penna.

Offices in BIRDSBORO, PA. *and* PITTSBURGH, PA.

STEEL MILL MACHINERY

Designers and Builders of:
Steel Mill Machinery • Crushing Machinery • Rolls
Hydraulic Presses • Special Machinery • Steel Castings

MM 19-51-R

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AIRE-RECTIFIERS
THE ORIGINAL SPLIT SYSTEM

AIR CONDITIONERS FOR CRANE CABS and PULPITS

Following is a partial list of users of Lintern Aire-Rectifiers. Without exception, the original installation has been followed by repeat orders.
We value highly the confidence thus expressed in our product.

Allegheny-Ludlum Steel Corporation
Aluminum Company of America
Cleveland, Ohio, Tennessee, Texas
Davenport, Iowa and Edgewater, N. J. Plants
American Steel Foundries
Buick Motor Division, Genl. Motors
Oldsmobile Division, Genl. Motors
Atlantic Steel Company
Bethlehem Steel Corporation
Bethlehem, Lackawanna, Steelton, Sparrows Point and Johnstown
Birmingham Slag Company
Canadian Carborundum Company
Colorado Fuel and Iron Company
Crucible Steel Company
Detroit Steel Corp.
Dominion Forge and Stamping Co., Ltd.
Dominion Foundries and Steel, Limited
Duncan Foundry and Machine Company
Electro-Metallurgical Company
Ford Motor Company
Detroit and Canadian Plants
Great Lakes Steel Corporation
Granite City Steel Company
Government Projects
Inland Steel Company
Jones and Laughlin Steel Corporation
Otis Works and Aliquippa, Pa.
Kaiser Steel Corporation
Kennecott Copper Company
Keystone Steel and Wire Company
Laclede Steel Company
Lone Star Steel Company
Lukens Steel Company
McClough Steel Corporation
Missouri Portland Cement Company
National Carbon and Carbide Corp.
Newmont Mining Company
Newport Steel Corporation
Northwestern Steel and Wire Company
Page Hershey Tubes, Ltd.
Pittsburgh Metallurgical Company
Pittsburgh Plate Glass Company
(Columbia Cement Division)
Pittsburgh Steel Corporation
Republic Steel Corporation
Cleveland, South Chicago
Reynolds Alloy Corporation
Rotary Electric Steel Company
Standard Steel Spring Company
Southern Acid and Sulphur Company
Stanley Works
American Tube and Stamping Plant
St. Lawrence Alloys Company, Ltd.
Timken Roller Bearing Company
U. S. Navy
U. S. Steel Company
Gary Steel Works
Gary Sheet and Tin Mill
South Chicago, Ohio, Mac Donald and Fairless Works
American Steel and Wire Division
Cleveland, Donora
Columbia-Geneva Steel Division
Provo, Pittsburgh, California
National Tube Division
Gary, Lorain, McKeesport
Weirton Steel Company
West Virginia Pulp and Paper Company
West Virginia Steel Company
Westinghouse Electric Company
Wheeling Steel Company
Steubenville, Benwood
Willis-Overland
Wisconsin Steel Company
Youngstown Sheet and Tube Company
Indiana Harbor and Campbell Works

Lintern Aire-Rectifiers have been installed also on cranes for England, France, South Africa, Chile, Luxemburg, Australia, and Brazil.

SUCH *Preference* MUST BE MERITED

THE LINTERN CORPORATION
P. O. BOX 428 PAINESVILLE, OHIO

ELECTRIC FURNACE ADDS SUBSIDIARY

▲ The Electric Furnace Co., Salem, Ohio, announces the incorporation of a subsidiary company in Canada to be known as Canefco, Ltd., with headquarters at 137 Wellington St., West, Toronto 1, Ontario. The officers of this new Canadian company are: D. E. Moody, president; K. U. Wirtz, vice president; and H. E. Farintosh, secretary-treasurer.

K. U. Wirtz, vice president, is also president of Electric Furnace Co. with which company he has been associated for over 25 years.

WEST COAST BRANCH TO BE OPERATED BY ACP

▲ American Chemical Paint Co. announces that it has acquired office and plant facilities on the West Coast and expects to be operating there about the first of November.

The new ACP plant is located at Niles, Calif., about 25 miles southeast of San Francisco.

Heading up the Niles ACP branch will be George H. Williamson, for many years associated with the American Chemical Paint Co. in a supervisory capacity at its Detroit, Mich. office. In addition, field representatives will provide technical servicing and consultation for ACP customers in the West Coast area.

WAREHOUSE, SERVICE SHOP BEING CONSTRUCTED BY GE

▲ Ground was recently broken for the General Electric Co.'s new $1,690,000 service shop and warehouse in Philadelphia, Pa., designed to serve the growing industrial needs of metropolitan Philadelphia and the Delaware River Valley regions.

Expected to be the largest G-E repair facility in the nation, the new structure is scheduled to go into operation in August, 1953. Park E. Fisher, G-E shop superintendent for Philadelphia, wielded the shovel, signalizing the beginning of construction at groundbreaking ceremonies.

"Our basic purpose for erecting this facility has been the rapidly expanding volume of steel mill and other industrial business in this area," Mr. Fisher told a group of civic, G-E and Pennsylvania Railroad officials.

"This modern, one-floor operation will be set up to handle all major transportation, utility and industrial apparatus," Mr. Fisher said. "It will be the most completely equipped facility of its kind that we have in this country."

Present G-E plans call for the use of the most modern service equipment available, such as a new magnet winding machine and a 35-ton crane. When the crane hook is raised to the level of the crane cab, it will be 24 ft from the floor; this will enable the shop to handle turbine fields with ratings up to 30,000 kw.

Located on the main line of the Pennsylvania Railroad at Erie and I Streets, the new building will have its own siding. The structure itself will take up 130,000 sq ft of floor space and 90,000 sq ft will be occupied by the service shop, with the balance devoted to the warehouse.

Though the former facility has been occupied since 1929, there has been a G-E service shop in Philadelphia since 1892.

The new warehouse has been designed to move approximately 60 tons of apparatus a day; if business volume warrants, larger crews could be put on to handle more equipment.

MINNEAPOLIS-HONEYWELL INCREASES SALES FORCE

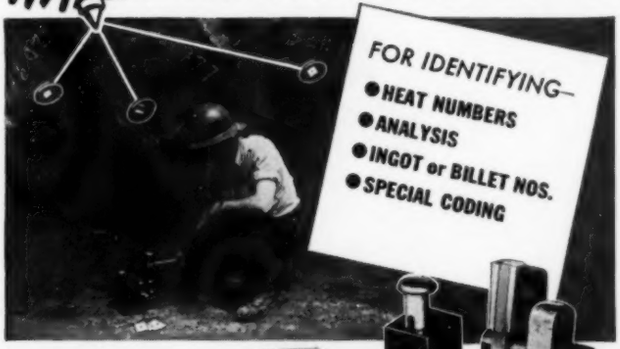
▲ Thirty-four sales engineers were recently added to the field sales force of Minneapolis-Honeywell Regulator Co.'s industrial division, it was announced by O. B. Wilson, field sales manager.

The new appointees, all recent graduates from the company's industrial instrument training school in Philadelphia, mark an over-all increase of 15 per cent in the field sales group this year, Mr. Wilson said. He pointed out that since 1946 additions to the company's field sales group have virtually paralleled industrial expansion, which has pyramided from nearly $13 billion in 1946 for new plants and equipment to an expected all-time high total of slightly more than $24 billion this year.

The new salesmen who will be assigned to 27 cities in 22 different states are: Edward J. Reulbach, New York; Kenneth Ryan, Ralph J. Fittipaldi and John P. Reynolds, East Orange; James E. Vanderveld, Boston; Richard E. Howard, Hartford; Joseph M. Heinold and Richard L. Kanehl, Buffalo; Don P. McAdoo, Baltimore; Albert J. Walcek, Washington; Robert H. Branch, Roanoke; Wilbur A. Dixon, Atlanta; Stephen M. Kennedy, Jacksonville; James T. Emerson, Greenville; John H. Buri, John B. Freeman and John Monsay, Philadelphia; Anthony J. Schneider, Cleveland, and Robert W. Meyer, Cincinnati.

Also, Thomas C. Farrell, Detroit; Warren G. Myers, Toledo; William B. Wells, Pittsburgh; Richard J. Bortoli and William Lyford, Chicago; Robert Lederer, Davenport; Robert G. Steel, St. Louis; Vincent T. Coffman, Tulsa; Thomas W. Clark, Denver; Joe C. Graham and Vernon S. Robyn, Seattle; Dwain M. Bates, Spokane; Richard C. Butler, San Francisco; Royce N. Crain, Los An-

NAIL IDENTIFICATION TAGS TO STEEL!



—with the
"SAFETY" TAG EMBOSSING and TAGGING OUTFIT

It's hard to believe, but it's true—this Outfit enables you to quickly nail metal identification tags to hot or cold steel ingots, billets, slabs, etc. Tags are embossed, pierced and nailed to steel by swinging hammer in the ordinary manner. Send for complete data today on this remarkable unit. *Write for Bulletin J-547*

M.E. CUNNINGHAM CO.
SAFETY STEEL STAMPS
1041 Chateau Street • Pittsburgh 33, Pa.

Browning Mill Type Cranes have PLENTY OF STRENGTH where strength is needed!

Satisfying A.I.S.E. specifications, Browning Mill Type Cranes incorporate types of motors and controls on which you have standardized. This flexibility suits your VRB crane *perfectly* to your needs. Our design, springing from 50 years' experience, places plenty of strength where it is required.

"Built as you yourself would build them"

Ask for our Bulletin "E"

VICTOR R. BROWNING & COMPANY, Inc.
BOX 309, WILLOUGHBY (CLEVELAND), OHIO
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

Engineered . . .

to permit greater load-speed capacity

Amerigear*
*Trade Mark Reg.
COUPLING
The Proven Gear-Type Coupling With Fully Crowned Teeth . . . A Major Improvement In Gearing. This proven gear-type coupling with fully crowned teeth is being utilized in solving a wide range of power transmission problems other than those common to ordinary gear-type couplings.
Pat. & Pat. Pending

THIS FUNDAMENTAL IMPROVEMENT in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. This tooth design accomplishes tight fit on the crown as well as on the flanks. It is the first gear tooth on which all the load is carried on strong flanks rather than tooth edges. It reduces backlash to a minimum. These advantages, plus thrust compensation, and correction for angular and lateral misalignments give maximum relief from coupling failure grief.

Amerigear Couplings, made in several standard types, are available for standard shaft sizes and a wide range of speed and load capacities. Catalog of standard type Amerigear Couplings is available on request. Amerigear Power Transmission Engineers are available for consultation.

AMERICAN FLEXIBLE COUPLING COMPANY

Originator of the Amerigear Fully Crowned Tooth
Sales Offices in Principal Industrial Centers
ERIE, PA., U.S.A.
AFFILIATE OF J. A. ZURN MFG. CO.

Write on your Business Letterhead for further information regarding *Amerigear Couplings* with the *Fully Crowned Teeth* and Catalog 501.

Also Manufacturers of
The Original "Oldham Type" American Flexible Coupling

geles, and William A. Gill, Indianapolis.

In addition, recent transfers include: Denis J. McDowell, from Chicago to Milwaukee; John H. Morrison, Greenville to Knoxville; Lester E. Dotts, Philadelphia to East Orange; Edward Nikstenas, Birmingham to Nashville; William J. Kirby, Los Angeles supplies sales to instrument sales; William P. Ryan, East Orange supplies sales to control device sales; Alex L. Zsiray, New York supplies sales to control device sales; Charton S. Slenning, Portland, Ore., service to industrial sales; Edward S. Crane, Buffalo to Philadelphia service; Thomas H. Jenkins, Chicago to Louisville, and Paul R. Sharadin, service to sales, El Paso.

NEW FURNACE IN PRODUCTION AT INLAND STEEL PLANT

▲ First step in an expansion program which will lift steel making capacity of Inland Steel Co. by 20 per cent was completed recently when one of four new open-hearth furnaces was put into production at the company's Indiana Harbor Works in East Chicago, Ind. The other three are scheduled for completion by the end of the year.

These four new open-hearths of 250-ton capacity each, will bring to 40 the total of steel-making furnaces at the Inland plant. They will increase the annual capacity of the plant from a present 3,750,000 tons of steel ingots to 4,500,000 tons.

Steel from the new furnaces will be rolled on present mills of the company which have capacity adequate for handling the additional tonnage, the company said.

WESTINGHOUSE TO EXPAND HYDE PARK OPERATIONS

▲ Westinghouse Electric Corp. will expand its manufacturing operations in the Boston, Mass., area soon with a $1,250,000 building project at its Sturtevant Division plant in Hyde Park, Mass. The Hyde Park plant manufactures air conditioning equipment, commercial fans, and blowers.

The increasing demand for Sturtevant Division products has seriously taxed the present facilities. The new structure is expected to provide sorely-needed space in which to expand but also an opportunity to make more efficient use of existing areas.

BABCOCK & WILCOX PURCHASES SHIPYARD

▲ Announcement that Babcock & Wilcox Co. had purchased facilities of a former shipyard from the Brunswick Port Authority at Brunswick, Ga., and would convert it into a plant to build boilers and related equipment was made recently.

The property involved consists of about 110 acres with about 250,000 sq ft under roof and was formerly the J. A. Jones shipyard before being acquired by the Brunswick Port Authority in 1945. The plant has not been used since the end of shipbuilding and will require considerable rehabilitation. This work, together with installing the necessary new equipment, will start immediately and production will start about the first of the year and build up to an employment of 400 by mid-1953.

This is the fourth new plant to be announced by the company in the past year, the other three being at Wilmington, N. C., West Point, Miss. and Paris, Tex. This brings to a total of 10, the number of Babcock & Wilcox plants, the remaining six being located in Barberton and Alliance (three plants), Ohio, Beaver Falls, Pa. and Augusta, Ga.

RECORD MONTHLY OUTPUT SET AT CLAIRTON WORKS

▲ That the long steel strike is a thing of the past as far as they are concerned was demonstrated with action by the several hundred employees in the steel works department at U. S. Steel's Clairton, Pa., works in August when they chalked up an all-time high for steel output in one month.

In the first month back at work, the plant's production of open hearth steel ingots soared to a record of 83,382 tons. That is almost 1,100 tons better than the best previous mark for any single month in the plant's 50-year history.

H. W. Seyler, plant general superintendent, said the employees displayed teamwork unsurpassed in his experience, to attain the record steel production. He said:

"The record speaks for itself. All of the employes pitched in and worked as a team. They forgot all about the strike, and in a big hurry."

Clairton steel goes into portable Bailey bridges for Army in Korea, locomotive springs, high voltage transmission towers and many other military and civilian uses.

SURFACE COMBUSTION MOVES IN DETROIT

▲ Surface Combustion Corp., manufacturers of industrial, domestic and commercial heating equipment, have moved to new offices at 10333 West McNichols Road, Detroit 21, Mich. The firm, which has headquarters in Toledo, has maintained offices in Detroit for over a quarter of a century. The company manufactures Janitrol domestic-commercial space heating equipment and 'Surface' industrial heat treating furnaces.

Abner Baker is manager of the Janitrol division district office and Walter F. Herdrich is manager of the industrial sales district office.

ATLANTIC STEEL TO OPEN WAREHOUSE THIS MONTH

▲ Atlantic Steel Co.'s new Warehouse Division building is being rushed to completion, and will be ready for occupancy this month, according to Robert S. Lynch, company president.

Marking the opening of these new facilities, the Warehouse Division will hold a two-day Open House on October 31 and November 1.

The new warehouse building, located at Fourteenth St. and Northside Drive, is adjacent to the West By-Pass and the Southern Railway.

Costing $500,000, the building is of steel and brick construction, with the 460 ft x 140 ft warehouse area on one level.

Mr. Lynch said the modern design and lay-out of the building will permit the most efficient handling and stocking of warehouse products and will assure prompt service to the customer.

One feature of the event will spotlight the versatility of stainless steel, and its use by some of the major industries. Individual displays, ranging from 32 to 44 ft in length, will be built to exhibit stainless steel equipment used in dairy, textile, and pulp and paper industries. Another display will show the stainless steel utensils and equipment used in hospitals.

A number of Southern metalworking plants and fabricators, using the company's carbon steel and other materials, have been invited to participate with exhibits of their products.

Featured also will be displays showing the uses of other materials carried by Atlantic Steel's Warehouse Division, such as cold drawn steel, expanded metal and copper.

LOCOMOTIVE DELIVERED TO BRAZILIAN RAILROAD

▲ The first two of 32 Baldwin-Westinghouse diesel-electric locomotives ordered last winter by Central Railways of Brazil have been delivered six months ahead of schedule, the Westinghouse Electric International Co. announced recently from its New York headquarters.

Five times more powerful than the first Baldwin-built locomotives delivered to the railroad 90 years ago—in 1862—the two 1,600-hp units weigh 170 tons each and exert a continuous tractive effort of 72,900 lb. The three steam locomotives placed in service 90 years ago weighed only 29 tons and boasted a tractive effort of 13,420 lb.

The railroad will receive twelve 170-ton units that will operate on broad gauge (63-in.) track, and twenty 118-ton units designed for meter gauge (about 39-in.) track.

The shipment is part of Central Railways' current program to extend diesel-electric operations to key sections of its lines, which provide service between Rio de Janeiro and Belo Horizonte and to the surrounding area. Replacement of the present steam locomotives is expected to reduce operating costs even though fuel oil must be imported.

The Baldwin-Lima-Hamilton Corp., Eddystone, Pa., is building the mechanical parts and assembling the locomotives, for which Westinghouse is manufacturing complete electric traction units. Delivery of all 32 units is scheduled for completion by the first quarter of 1953.

Banish the "Bite"

ON PICKLING AND PLATING EQUIPMENT

with these NATIONAL (TRADE-MARK) CARBON AND GRAPHITE AND KARBATE (BRAND) IMPERVIOUS GRAPHITE PRODUCTS

Pickling and tinning are messy, expensive — and *necessary*. However, you can *greatly reduce* equipment maintenance costs and improve plant housekeeping by making full use of these National Carbon products wherever service is dirty and tough. As is well known by manufacturers of your pickling and plating *solutions*, only carbon and graphite and impervious graphite withstand the "bite" of so wide a range of corrosive chemicals.

HERE'S WHERE THEY'RE USED:

STAINLESS PICKLING

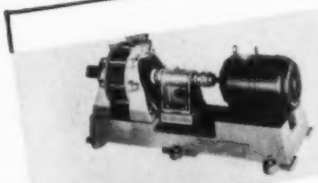
Carbon brick tank linings with "Karbate" Plate-Type Heat Exchangers and drain lines offer powerful resistance to nitric-hydrofluoric solutions.

ELECTROLYTIC PLATING

Graphite Anodes, either alone or in combination with dissolving-type anodes, are non-contaminating and long lasting.

Various immersion-type and shell-and-tube type "Karbate" Heat Exchangers are available to suit capacity requirements.

CARBON STEEL PICKLING



"Karbate" pumps and piping resist sulphuric and hydrochloric acid attack . . . protect solution from contamination.

"Karbate" Shell-and-Tube Heat Exchangers are often most economical where more than 50 square feet of heat transfer surface is required.

Graphite Tank Rolls provide an ideal combination of good electrical conductivity and resistance to acid attack in electrolytic pickling operations.

WRITE FOR CATALOG SECTION—S-5005

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BLAST FURNACE LININGS • BRICK • CINDER NOTCH LINERS • CINDER NOTCH PLUGS • SKIMMER BLOCKS • SPLASH PLATES • RUNOUT TROUGH LINERS • MOLD PLUGS • TANK HEATERS

Personnel News...

E. R. Johnson has been named district manager for Republic Steel Corp. in its central district, Canton and Massillon, Ohio, succeeding **George W. Putnam,** who has been made a consultant for the entire corporation. Mr. Johnson has been serving as assistant district manager, a position which has been filled by **O. A. Bamberger,** former superintendent of the Canton plant. **L. M. Immel,** formerly superintendent of the Canton blooming mill has been made plant superintendent at Canton. **Joseph Charlton,** who was located at the Massillon plant, succeeds Mr. Immel as superintendent of the Canton blooming mill. All of these men have been associated with Republic and its predecessor companies for more than 30 years. **Peter T. Reynolds** becomes assistant superintendent of the blooming, billet and bar mills at the Massillon steel plant. He succeeds Mr. Charlton. **E. Ernest Weatherbee** is appointed roll designer at the Massillon steel plant, succeeding Mr. Reynolds. **J. Fred Mertes** becomes the district manager's clerk. He succeeds **R. M. Frank,** who died recently.

R. L. Bernhard, was named manager of the newly-created centrifugal compressor department of the American Blower Corp.

J. P. D. Gerrese was appointed chief engineer of the Gary, Ind., plant, National Tube division, U. S. Steel Co. Associated with U. S. Steel since 1925, he has been control engineer of National Tube's construction department since 1947.

Alex Montgomery, Jr. has been appointed assistant to vice president — rolling mills, United States Steel Co. In this newly created position Mr. Montgomery will assist the vice president in all matters pertaining to rolling mill operations of the company. Mr. Montgomery, who has been assistant general superintendent of the company's Duquesne, Pa., Works, will be succeeded by **Oscar Pearson,** who comes to Duquesne from Gary, Ind., works of United States Steel Co., where he has been division superintendent of steel production.

Frank Newell was named branch manager for Pangborn Corp., at Rock Island, Ill.

Elmer A. Koenig was named sales manager of Yoder Co., Cleveland, Ohio. Mr. Koenig has been assistant sales manager for the past three years. He was advanced to this position after ten years of service with the company as a sales engineer.

George A. Schiller has been named assistant sales manager of the Dollinger Corp., Rochester, N. Y. He was formerly associated with the Dustex Corp., Buffalo, N. Y.

C. Robert McCloskey has been named sales manager by Furnace Engineers, Inc., Pittsburgh, Pa. Mr. McCloskey was formerly associated with Salem Brosius, Inc., in Salem, Ohio.

L. S. Brumgard has been appointed manager of General Electric's apparatus sales office in Trenton, N. J. He will replace **E. H. Powell,** who will assume the duties of assistant manager at the G-E apparatus sales office in Richmond, Va.

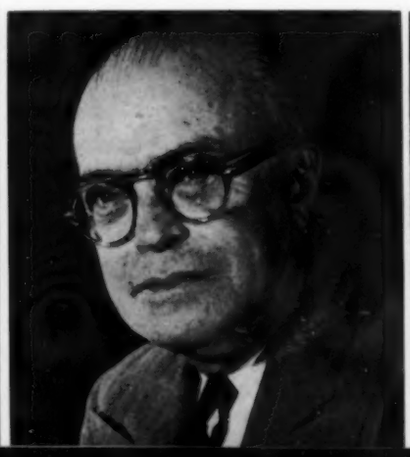
Meryl H. Geisking was named to the newly created position of assistant to president of Tennessee Coal & Iron Division of United States Steel Co. at Birmingham, Ala. Mr. Geisking is succeeded by **David A. Challis, Jr.,** assistant general manager of sales for United States Steel Co. in Pittsburgh, Pa.

Edward C. Speter has been appointed assistant director of industrial relations in charge of labor relations for American Steel and Wire division of U. S. Steel Co., Cleveland, Ohio. Mr. Speter succeeds **Axel H. Olson** who has been named assistant director of industrial relations on special assignments.

Andrew Gagarin was elected president of Torrington Manufacturing Co., Torrington, Conn., effective January 1, 1953. **S. W. Farnsworth** will become chairman of the board on that date. Mr. Farnsworth, who is currently president, will continue to devote his full time to daily problems of the business. Mr. Gagarin is currently vice president of the company.

E. R. JOHNSON

O. A. BAMBERGER



L. M. IMMEL

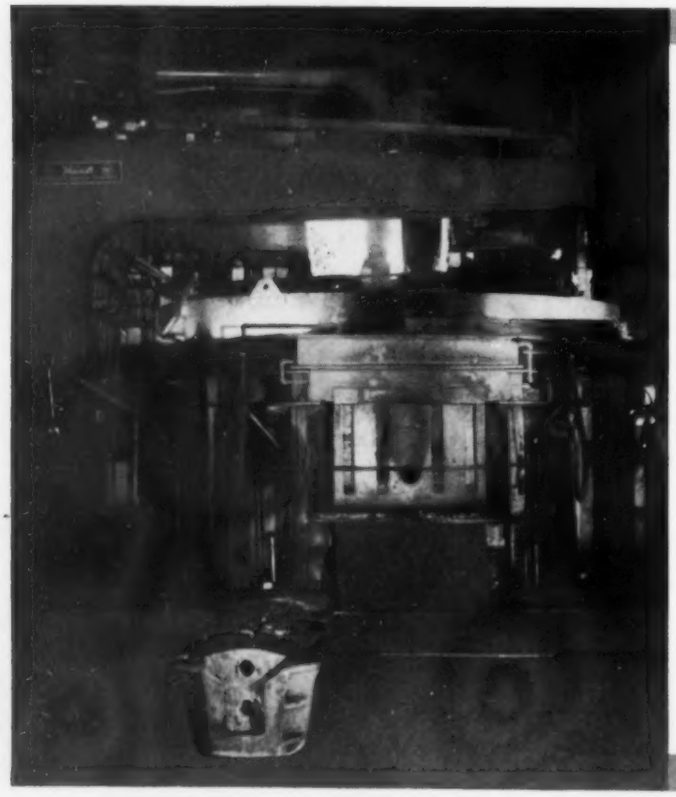
ALEX MONTGOMERY, JR.

Julius A. Clauss, vice president in charge of engineering, Great Lakes Steel Corp., Ecorse, Mich., retired October 1. Mr. Clauss passed his retirement age some time ago but remained on the job to supervise completion of the company's new blast furnace D. Lighting

JULIUS A. CLAUSS

of this furnace September 22 climaxed a career in which he engineered development of a desolate swampland area into a completely integrated plant now producing steel at the rate of 3,150,000 tons annually. **Donald E. McGuire** was promoted to succeed Mr. Clauss as vice president in charge of engineering. Mr. McGuire has been chief engineer since 1946, and joined the company in 1929. Mr. Clauss has been associated with the steel industry more than 50 years, having started with the Lackawanna Steel Co. at Lackawanna, N. Y. as an apprentice machinist while studying mechanical engineering and metallurgy. He subsequently was employed by the Republic Steel Corp. at Buffalo, N. Y., as draftsman. He was chief engineer for the Trumbull Steel Co., Warren, Ohio, when he was selected for the challenging job to engineer plant construction for the then newly-organized Great Lakes Steel Corp. During World War II, Mr. Clauss served with the War Production Board as chief of steel plant facilities and special assistant to the steel division director. He returned to Great Lakes Steel in November, 1943, and the following year was promoted to a vice president. Mr. Clauss is a past president of the Association of Iron and Steel Engineers and was responsible for the founding of the Detroit District Section of this Association.

J. D. Greensward was named vice president, director of manufacturing, general machinery division, Allis-Chalmers Manufacturing Co., Milwaukee, Wisc. **P. F. Bauer** has been named general manager of the Norwood, Ohio, works and manager of the firm's apparatus department succeeding Mr. Greensward. Prior to being named general manager of Norwood works, Bauer was manager of the general machinery division's central sales region with headquarters in Cleveland.



Heroult

ELECTRIC MELTING FURNACE

. . . as ever, the dependable furnace for the production of high-grade stainless, alloy and rimming steels.

Removable roof of new design now available for the larger furnaces.

AMERICAN BRIDGE DIVISION
UNITED STATES STEEL COMPANY

General Offices: 525 William Penn Place, Pittsburgh, Pa.
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AMERICAN BRIDGE

USS

UNITED STATES STEEL

NEW

Fast Arc Blowout

Two Type 260 DC Contactors, 150 amp, single pole, normally open, with auxiliary switch. One arc chute has been removed to show control detail. Type 260 DC Contactors with the new Arc Centering Feature are rated 600, 300 and 150 amps at 600-volt maximum.

ALLIS-CHALMERS Mill Type 260 DC CONTACTOR

- **Speeds Arc Interruption**
- **Extends Contact and Chute Life**

THIS NEW HEAVY DUTY CONTACTOR offers an *entirely new* principle of arc interruption . . . developed by Allis-Chalmers engineers to meet the exacting needs of industry.

Contact and arc chute life have been greatly extended by an *arc centering blowout*. In centering the arc, increased blowout action and fast interruption results from a combination of thermal convection and magnetic action. Contact erosion is reduced and carbonization is minimized.

Other advantages of the Mill Type 260 DC Contactor include: accessible construction for easy maintenance; ROLLING contact action with no destructive scuffing; design simplicity which has eliminated troublesome linkages, arms and pivots.

The Type 260 DC Contactor featuring the new arc interruption principle has been designed and built to steel mill engineers' specifications. Years of field and factory tests have proved this heavy duty contactor far exceeds NEMA requirements . . . have established it as an efficient, trouble-free performer under the most severe operating conditions. Call your nearby Allis-Chalmers District Office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 14B6505A.

A-3871

How Arc Interruption Principle Works

Arc Chute Assembly consists of triangular metal plates with U-shaped segments mounted alternately. Plates are insulated from each other and are placed at right angles to circumference of contact travel.

Metallic segments act as individual blowout coils.

Arc is forced upward along arc runner by blowout coil and impinges on metal segment of arc chute.

As contacts separate further, arc is stretched across an increased number of segments.

Arc rises quickly due to thermal and magnetic action of each individual metal segment.

ALLIS-CHALMERS

Ralph W. Dixon was named division superintendent, west mills, and **Edwin J. Blanning** as division superintendent, central mills, succeeding Mr. Dixon, at the Gary, Ind., works of United States Steel Co. Mr. Blanning was assistant division superintendent of primary mills at the time of his present appointment.

WILLIAM E. HASKELL

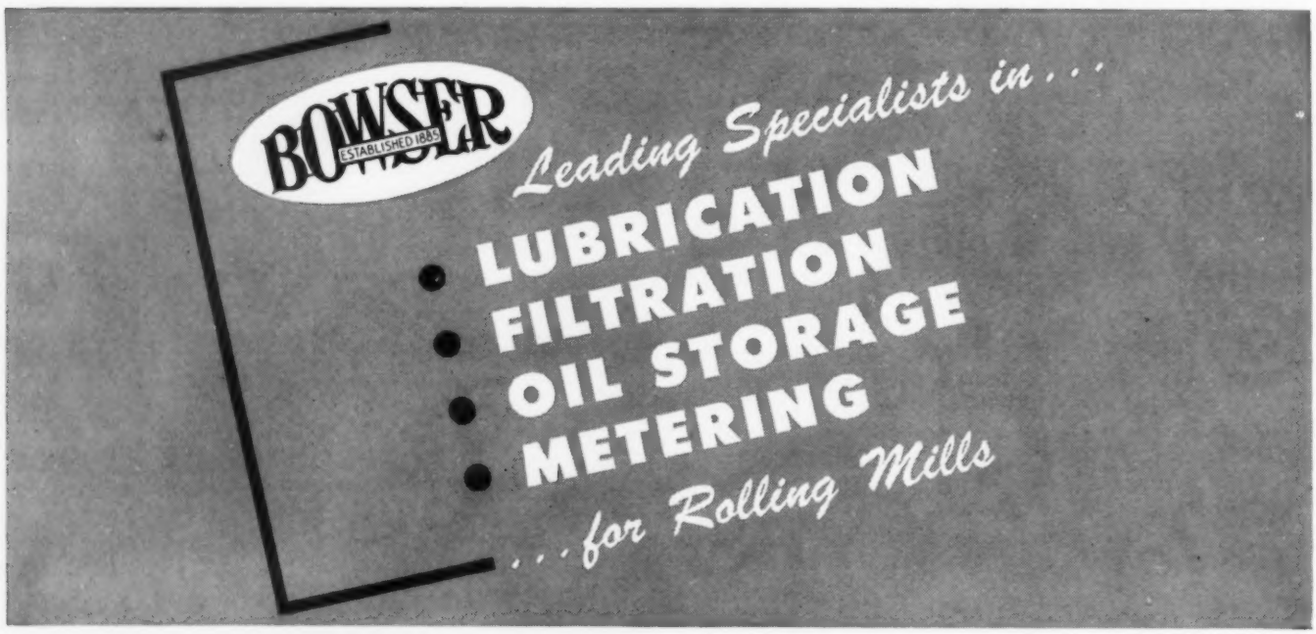
William E. Haskell has been appointed assistant division superintendent of primary mills at United States Steel Co.'s Youngstown, Ohio, district works. Mr. Haskell succeeds Edwin J. Blanning, who has been transferred to the company's Gary, Ind., works as division superintendent, central mills.

H. E. Boedecker has been appointed general superintendent, mechanical and electrical maintenance, Rotary Electric Steel Co., Detroit, Mich. Previous to this appointment, Mr. Boedecker had been connected with the Brazilian National Steel Co., Volta Redonda, Brazil, in the capacity of general superintendent,

H. E. BOEDECKER

maintenance for the past five years. Mr. Boedecker has also had a broad experience in steel plants in the United States.

Carl H. Mueller was named to the position of director of engineering for Lincoln Engineering Co.,



Bowser lubrication and liquid control systems have earned an enviable reputation for dependability in many rolling mills and other industrial plants. Sizes and equipment range from individual units to complete systems that serve entire plants. Bowser equipment minimizes downtime losses and maintenance costs . . . stays on the job day-in-and-day-out.

Our Engineers Are Always At Your Service

BOWSER, INC., 1370 Creighton Avenue, Fort Wayne 2, Indiana

• THE STANDARD OF THE INDUSTRY FOR MORE THAN 54 YEARS •

St. Louis, Mo. Mr. Mueller formerly assistant to the president in charge of product development will assume full charge of the engineering and research activities of the company.

C. R. Sizemore was promoted from manager of basic operations to general plant manager in charge of all Pittsburgh Coke and Chemical Co. Neville Island, Pa., plant operations.

Robert W. Crozier was named regional manager in charge of the Pittsburgh, Pa., and Cleveland, Ohio, offices of Electro Metallurgical Co. Mr. Crozier was serving as assistant division manager for the Pittsburgh-Cleveland sales area.

William M. Terry, Jr. has been appointed assistant chief engineer at Allis-Chalmers Pittsburgh, Pa., works.

Willard G. Cook was named manager of a newly established industry engineering department for Elliott Co. with offices at 715 Frick Building, Pittsburgh, Pa. For the past eight years Mr. Cook was steel mill consulting and application engineer for Westinghouse Electric Corp.

Emmett F. Cary, who has been district sales manager of the coupling department of Koppers Co., Inc., has been named district sales manager for the company's entire metal products division. He will be the district representative for the division's line of Fast's self-aligning couplings, piston rings, Koppers "Elex" electrostatic precipitators, "Aeromaster" industrial fans, gas apparatus and for the division's contracting department. With headquarters in Pittsburgh, his territory will include Western Pennsylvania, West Virginia and part of Ohio. A native of Donaldsville, La., he began his career with Koppers as a district sales manager for the company's Bartlett Hayward plant in Baltimore. Prior to joining Koppers he was associated with the Falk Corp. and the Castle and Wilson Engineering Co.

James H. Sutherland has been appointed manager of the Pittsburgh, Pa., district office of SKF Industries, Inc. Mr. Sutherland, who was assistant district manager for SKF at Pittsburgh, prior to his new appointment, has had long service in the steel and heavy manufacturing industries. He is a graduate of Carnegie Tech and was formerly with the Youngstown Sheet and Tube Co. He joined SKF in 1943, and until his transfer to Pittsburgh, he was the steel plant division senior engineer, at the company's main office in Philadelphia. He will continue to make his headquarters at 1518 Grant Building, Pittsburgh 19, Pa.

Robert L. Holt was named vice president of Bowser, Inc., Fort Wayne, Ind.

J. W. Mull, Jr. was named sales representative of Sintercast Corp. of America for Indiana, Western Ohio and Northern Kentucky.

STOP THE BIGGEST THIEF IN AMERICA

OAKITE GIVES YOU THREE WAYS TO FIGHT RUST

Day and night—wherever your steel is stored or handled—RUST, the biggest thief in America, is robbing you of production, robbing you of profit

Oakite can help you defeat rust these three ways:

☆ 1 By removing rust from raw steel.

☆ 2 By preventing rust during processing.

☆ 3 By preventing under-coat rusting of painted products.

FREE For the Oakite Anti-Rust Kit describing these ways to stop RUST in your plant, write to Oakite Products, Inc., 19 Rector St., New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE SPECIALIZED INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

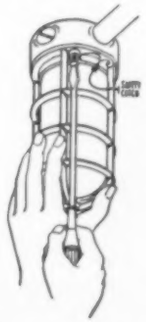
Weatherproof lighting units *with* vibration-proof bayonet guard

1 slips on—turns

All types and sizes in strong, rustless aluminum alloy. Junction box type adapts to all runs.

Bulletin E-5-52

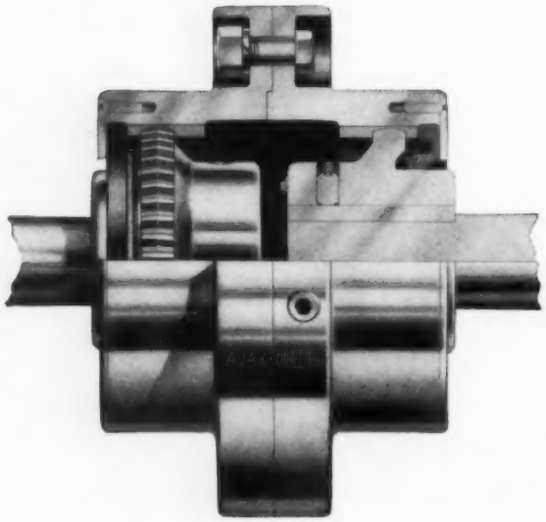
THE ADALET MANUFACTURING CO.
CLEVELAND 11, OHIO



2 in place to stay!

AJAX DIHEDRAL

New Coupling STEEL MEN Have Waited For



▶ Ability of Ajax Dihedral Couplings to handle extreme misalignment is the talk of hard-boiled steel men everywhere.

Exclusive Dihedral tooth shape provides for misalignment up to 4 degrees as stock off-the-shelf couplings. 6, 8, 10 and 12 degree teeth cut to order.

Save costly hours of setup, change-over and maintenance time. Line up motors in minutes not hours.

Write for facts on this radically new and exclusive coupling.

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, NEW YORK

E. M. Webb, vice president and general manager of Duff-Norton Manufacturing Co., Pittsburgh, Pa., has been elected a member of the board of directors of the company. Mr. Webb has been associated with Duff-Norton for 28 years.

S. Frederick Magis, consulting engineer with 26 years experience in the steel industry, has been named steel technologist at Armour Research Foundation of Illinois Institute of Technology.

Paul E. Nelson was named general foreman in the cold rolling and annealing departments of the Kaiser Steel Corp. tin mill at Fontana, Calif. Mr. Nelson started at Kaiser Steel as a laborer in the pipe mill in 1948, leaving a position as field engineer for an engineering firm in Los Angeles. He was appointed shift foreman the same year, and in 1951 was made general foreman, annealing department, in the tin mill.

Harry R. Sanow was named general superintendent of Acme Steel Co.'s Riverdale works, Riverdale, Ill.

HARRY R. SANOW

Since January, 1950, Mr. Sanow has been serving as director of the manufacturing divisions.

W. S. Truesdell was named to the newly created position of assistant general manager of Buffalo Steel division, H. K. Porter Co., Inc. Mr. Truesdell has been general sales manager and will continue his supervision of sales while assisting in the overall management of the division. He has been with the company for 22 years and has held various positions in sales and administration.

Arthur I. Schell was appointed as manager of operation methods at Midvale Co.'s plant in Nicetown, Philadelphia, Pa.

Edgar B. Speer has been appointed division superintendent of steel production at Gary, Ind., works of U. S. Steel Co. He succeeds **Oscar Pearson,** who will become assistant general superintendent at Duquesne, Pa., works of U. S. Steel Co. Succeeding Mr. Speer as assistant division superintendent of steel production is **E. Courtney Sorrells,** who for the past year has been superintendent of the No. 5 open hearth at Gary works.

In 1926 Heyl & Patterson built its first ore bridge for Weirton Steel Company. This bridge, now 26 years old, is still efficiently unloading, stocking and reclaiming ore for the Weirton blast furnaces.

1

In 1942 the second H & P ore bridge for Weirton Steel was put into operation. This bridge is essentially of the same dimensions and runs on the same tracks as the original bridge. It also includes extra sturdiness, more safety features, greater ease of control and provisions for lower maintenance.

2

3

In 1952 the third ore bridge was designed, fabricated and erected by Heyl & Patterson for Weirton Steel. Because of the efficient and successful performance of the first two H & P bridges through the years, this latest bridge is, by request, almost an exact duplicate of the bridge built in 1942.

ORE BRIDGES at WEIRTON STEEL COMPANY

The performance record of the three Ore Bridges at Weirton Steel Company, designed, fabricated and erected by Heyl and Patterson, illustrates the sturdiness, dependability and efficiency built into every piece of Heyl & Patterson Heavy Bulk Materials Handling Equipment. Heyl & Patterson has the experience, facilities and personnel to do THE WHOLE JOB . . . ALL THE WAY FROM DESIGN to ERECTION.

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SLAG SHOVEL OPERATORS SAFER, HEALTHIER WITH DRAVO CRANE CAB COOLER

DUQUESNE SLAG PRODUCTS COMPANY ELIMINATES WORKING HAZARD

Concentration of noxious fumes and steam, resulting from water sprayed on hot slag to aid in digging, create difficult working conditions for slag-handling power shovel operators.

Duquesne Slag Products Company, operating in slag pits of Jones & Laughlin Steel Corporation, has removed this working hazard by installing a Dravo Crane Cab Cooler on the cab roof of the shovel. Results: shovel operators are healthier, safer, more efficient and less fatigued; productivity increases.

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Dravo Crane Cab Coolers and Conditioners are eliminating similar working hazards for crane operators in open-hearth, stripping and hot-coil storage operations . . . in foundry, pickling and reduction work . . . and in aluminum, copper, magnesium, lead, chemical and cement production.

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Only at Dravo can you get a complete line of crane cab coolers and conditioners. This equipment is ruggedly constructed, factory assembled and pre-tested; all parts readily accessible for easy maintenance. Dravo Crane Cab Coolers and Conditioners are easily installed with a minimum of down-time required. Units are available for prompt delivery.

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William G. Walk, who has been division superintendent of the heat treating and forge department at U. S. Steel Co.'s Homestead, Pa., works succeeds **W. W. Scherer** as division superintendent of maintenance. Mr. Walk joined U. S. Steel in 1930 at Clairton, Pa., works. Named assistant division superintendents of maintenance are **W. T. Smith** and **C. J. Degenhardt.** Mr. Smith has advanced through various maintenance jobs since starting at Homestead in 1912. Mr. Degenhardt started to work at Homestead in open hearth No. 1 in 1916. **Robert O. Thomas** becomes division superintendent of the heat treating and forge department. With U. S. Steel since 1933, Mr. Thomas was open hearth division superintendent at the time of his present appointment. **Edward E. McGinley,** who has been division superintendent of steel production at the company's Youngstown district works, succeeds Mr. Thomas. Mr. McGinley joined U. S. Steel in 1936 at Ohio works in Youngstown. **Lewis A. Hovey** advances from superintendent of open hearth No. 5 to assistant division superintendent, open hearth and foundry. Mr. Hovey first joined U. S. Steel as a metallurgical observer at Homestead in 1933. **William E. Brandt,** who has been superintendent at open hearth No. 4, steps up to the same position in open hearth No. 5. He started at Homestead in 1939 in the chemical laboratory. **John W. McGill** moves up from assistant superintendent at open hearth No. 5 to superintendent of open hearth No. 4. Mr. McGill started with the company in 1925 as a pit recorder at Duquesne works. Succeeding Mr. McGill as assistant superintendent of open hearth No. 5 is **Robert W. Steigerwalt,** former assistant superintendent of open hearth No. 3. Mr. Steigerwalt's U. S. Steel service dates to 1936 when he started as a laborer. **Alexander F. Boyd, Jr.** becomes assistant superintendent of open hearth No. 5 after one year as assistant to the superintendent of open hearth No. 3. He started in the metallurgical department at Homestead in 1941.

John D. Peters was appointed as manager of purchasing research in United States Steel Co.'s purchasing division. Prior to his present appointment, he was staff assistant to the assistant executive vice president — accounting, United States Steel Co.

R. G. Baker was named as regional sales representative for DeLaval Steam Turbine Co., Trenton, N. J. In his new post, Mr. Baker's sales representation will extend over the territories of the company's Chicago, Detroit and Minneapolis operations, but will continue to make his headquarters in Chicago, Ill. He has been manager of the Chicago district office since 1934. The appointment of **C. C. Bray** was also announced as manager of the Chicago district office. Mr. Bray will assume charge of all sales activities of the company in this territory. He was formerly manager of the midwest district office of the company's standard product division.

William R. Call has been named service supervisor for the mid-Atlantic region of Allis-Chalmers general machinery division with headquarters in Philadelphia, Pa.

A. B. FISHER, JR.

F. W. RYS

ARTHUR J. WHITCOMB

JOHN E. ANGLE

A. B. Fisher, Jr., of Koppers Co., Inc., has been appointed a vice president in the company's engineering and construction division in Pittsburgh, Pa. In his new post Mr. Fisher will serve as executive assistant to the general manager and assistant general manager of the division. He will be the principal liaison officer between the division's headquarters in Pittsburgh and the Chicago headquarters of the Koppers Freyn engineering department. Succeeding Mr. Fisher as operating manager of the Freyn engineering department will be **F. W. Rys,** now assistant sales manager. Taking over Mr. Rys post as assistant sales manager will be **Arthur J. Whitcomb,** manager of specialty sales. **W. C. Schofield** assumes the position of manager of specialty sales. He has been with Koppers and Freyn Engineering for the past 32 years in successive posts of chief designer, assistant chief engineer, chief engineer and assistant product manager.

Mr. Whitcomb is secretary of the Chicago district section of the Association of Iron and Steel Engineers.

John E. Angle was named general superintendent of the Gary sheet and tin mill of United States Steel Co. Mr. Angle succeeds **Charles A. Ferguson** who, having reached the retirement age of 65, retired on September 30 after almost 40 years of service with U. S. Steel. Mr. Angle, 43, started his career in the steel industry in June, 1932, immediately after graduating from

COLUMBIA

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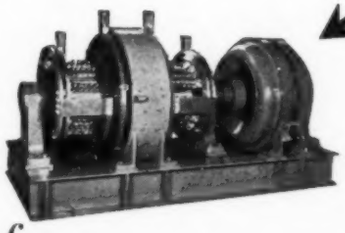

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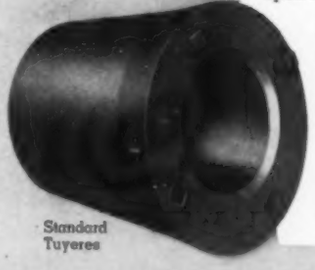

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Lehigh University with a B.S. degree in metallurgical engineering. His first job was junior metallurgist at the mill he is about to head. He advanced through various supervisory capacities — turn foreman in the sheet mill cold reduction department, chief metallurgist in the sheet mill, division superintendent in the sheet mill — and on January 1, 1944, he was appointed assistant general superintendent of the plant, the job he has held until his present appointment. Mr. Ferguson's retirement brings to a close a 40-year career with United States Steel, which began in February, 1913, at the American Sheet and Tin Plate Co. plant at Vandergrift, Pa. Five years later he was transferred to the Farrell works of the same company as master mechanic, and in 1927 was made assistant manager of the plant. In March, 1935, he moved up to manager of the Farrell works. Mr. Ferguson came to the Gary sheet and tin mill in 1938 as assistant general superintendent, and on December 1, 1943, was made general superintendent.

ARTHUR HJORTSBERG

Arthur Hjortsberg was appointed assistant chief metallurgist of U. S. Steel Co., with offices in Pittsburgh, Pa. Mr. Hjortsberg's entire career in the steel industry has been with United States Steel at its Gary works. Beginning in 1925 as a metallurgical observer, he advanced through various positions in the metallurgical department until becoming assistant chief metallurgist in 1940. A year later he was made assistant division superintendent of the plant's central mills and in 1943 became superintendent of this division. He has been assistant general superintendent, operating division, since 1945.

M. Michel has been appointed plant engineer of the Newark, Ohio, works of the Kaiser Aluminum & Chemical Corp. Mr. Michel formerly was employed in the central engineering department of the Aluminum Corp. of America with headquarters in Pittsburgh, Pa.

Lyle F. Gulley, formerly purchasing agent at Granite City Steel Co., Granite City, Ill., has been appointed assistant to the vice president in charge of operations. **Robert B. Leggat,** chief expediter, was named to succeed Mr. Gulley as purchasing agent.

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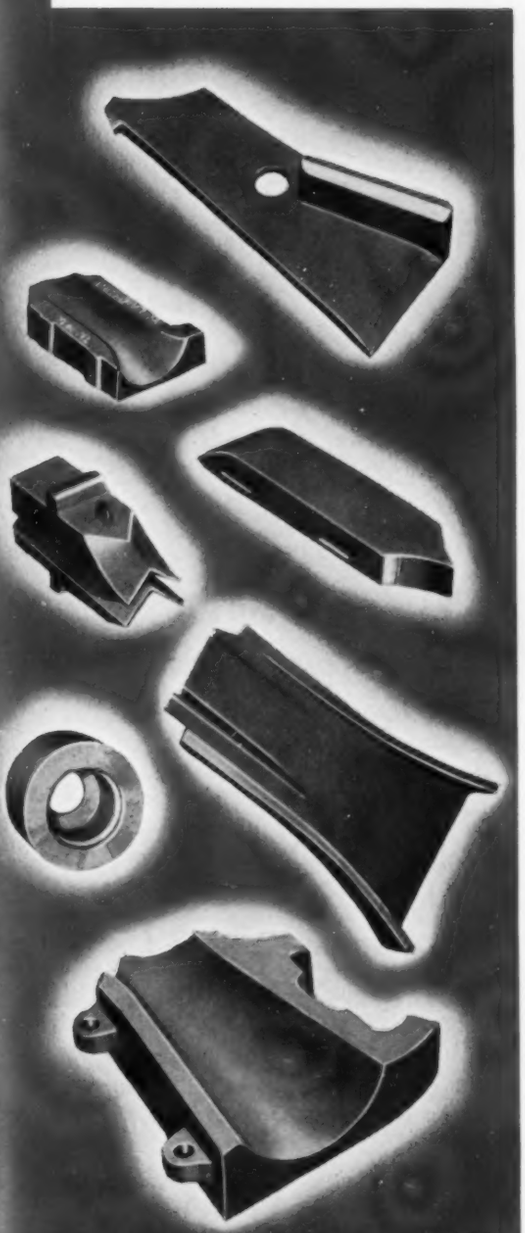

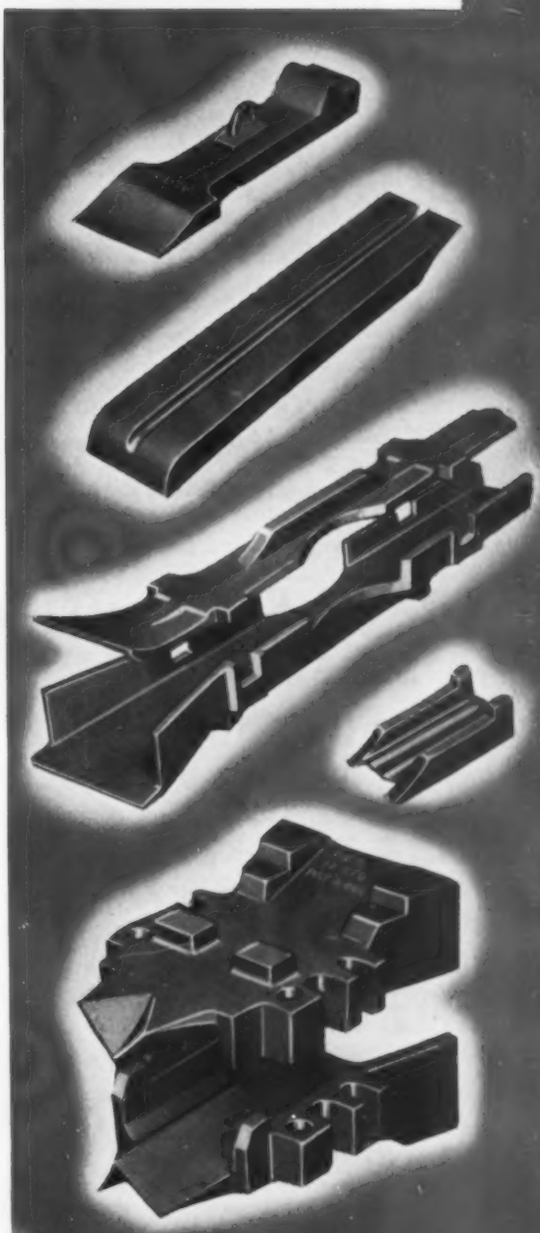

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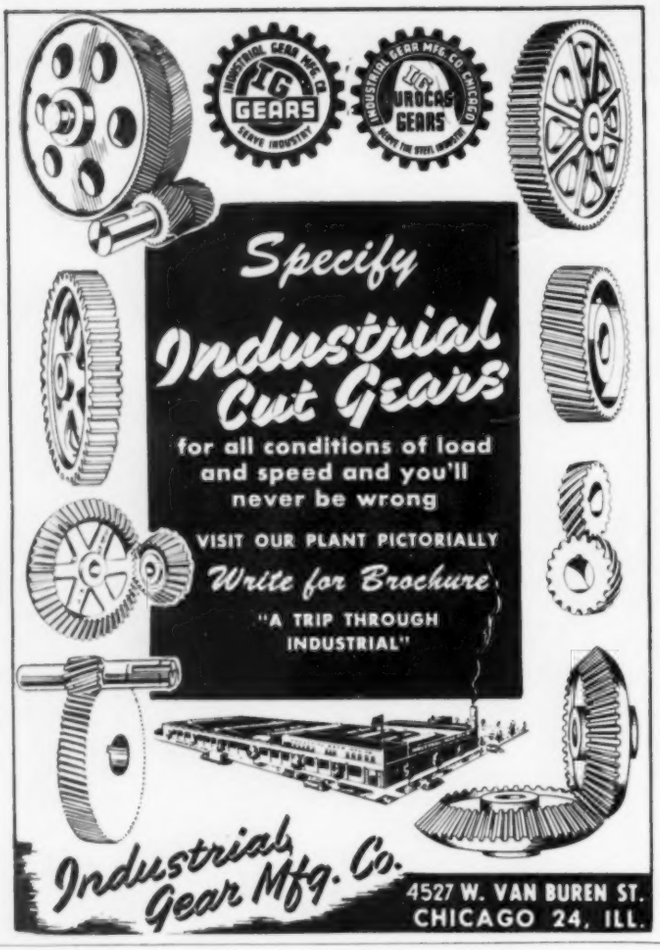
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George W. Roper has been promoted to the position of assistant technical director of the dust and fume control division, at American Wheelabrator & Equipment Corp., Mishawaka, Ind.

Robert W. Holman was named assistant general superintendent of the Gary, Ind., sheet and tin mill of United States Steel Co. Mr. Holman will fill the vacancy created by the appointment of J. E. Angle as general superintendent of the sheet and tin mill. At the same time it was announced that **Charles M. Shank** will succeed Mr. Holman as division superintendent of maintenance and utilities. Mr. Holman had been serving as division superintendent of maintenance and utilities. Mr. Shank joined U. S. Steel in 1926 as a mechanical engineer in the Pittsburgh offices of American Sheet and Tin Plate Co. He came to Gary sheet and tin mill in 1933 as assistant master mechanic and after several intermediate promotions was appointed superintendent of maintenance in 1946, the position he held at the time of his present appointment.

JOHN HELLSTROM

John Hellstrom, vice president of American Air Filter Co., Louisville, Ky. has been appointed director of sales of all AAF and Herman Nelson products. He will return from San Francisco, where he organized and managed the company's Pacific division, and will assume his new duties on the first of November. Prior to that time, the sales and advertising departments of the Herman Nelson division, Moline, Ill. are to be moved to Louisville and all sales including American Air Filter products will be under the direct supervision of Mr. Hellstrom. Assisting him will be **Robert W. Nelson,** vice president, formerly of the Herman Nelson division.

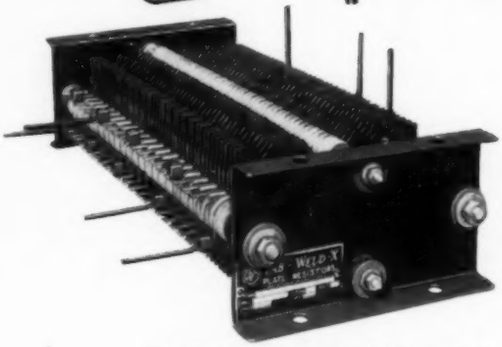
William B. Guffey was named as traffic manager of United Engineering and Foundry Co. following the retirement of **Leonard G. Hults.** Mr. Guffey will have charge of all transportation and traffic problems.

Arthur H. Beasley was appointed manager of the Memphis, Tenn., sales branch of Wagner Electric Corp. Mr. Beasley succeeds **A. Callaway Allen,** who recently became sales manager of Wagner's electrical division at St. Louis, Mo.

NEW RESISTORS

for Small H.P. Controllers WELDED Design Gives Many Advantages

Note top and bottom rows of grids with taps welded in place at the end of each grid. No intermediate taps on active material.



Standard mill section, 26½" long—also available in 18" and 12½" lengths.

Spot-welded to insure continuous current-path.

NOW, a standardized line of Welded Plate Resistors by EC&M for small HP controllers—below the range of the well known and popular TAB-WELD Sections for large motor applications.

These new TAB-WELD-X Plate Resistors have all the advantages of the larger sections: corrosion-resistant material—practically constant resistance-values between cold and working temperatures—clamp terminals—internal clamping-nuts maintain uniform overall dimensions—grids joined by welding—terminal-plates welded at the end of each grid for easy adjustment of resistance-value and providing strong supports for external connections.

Other inherent advantages are: no intermediate taps on active material—external leads along either side—lead-insulation not subject to resistor-heat—liberal spacing between grids (⅜") gives high heat radiation.

New Bulletin 942-B illustrates, describes and gives ratings of these new EC&M TAB-WELD-X Plate Resistors.

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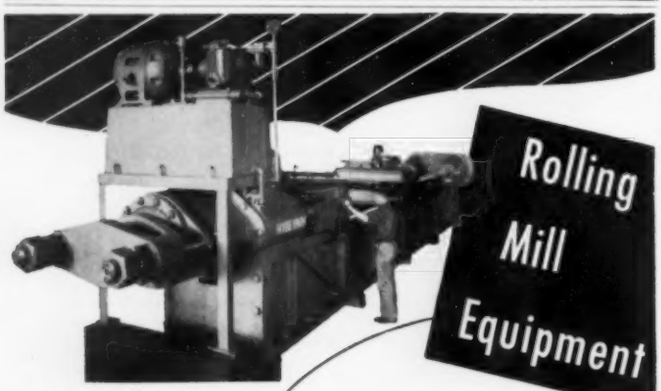

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Joseph P. Lencioni was named superintendent, cold roll department of Kaiser Steel Corp., Fontana, Calif., and **William J. Cox** as assistant superintendent, conditioning yards and cranes. Mr. Lencioni has been with the company since 1947 when he started as shift foreman, coming from the Carnegie-Illinois steel works, Gary, Ind., where he had been since 1933 and was assistant roller. Made general foreman in 1950, he was named assistant superintendent, cold roll, in 1951. In his new position Mr. Lencioni takes over former duties of **William B. Keirn.** Mr. Keirn is now superintendent in charge of tin mill operations. Mr. Cox, came to Kaiser Steel after ten years as schedule clerk and turn foreman with Columbia Steel, Torrance, Calif. Except for a year and a half at Geneva Steel, Provo, Utah, where he was employed as turn foreman in the structural mill, Mr. Cox has been with Kaiser since 1942 as recorder, shift foreman and since 1946 as assistant superintendent, soaking pits and blooming mill.

L. L. Dalbey was elected as treasurer and controller for Arms-Franklin Corp., Youngstown, Ohio. For the past 18 years he was secretary and treasurer of Aetna-Standard Engineering Corp. **Karl W. Matthes,** formerly sheet and tin mill design engineer for the United States Steel Co., construction engineering bureau, has been appointed chief engineer. **Alfred E. Tieg** is the chief draftsman. Before coming to Arms-Franklin Corp., he was associated with Patterson-Emerson-Comstock, Inc., United States Steel Co., Aluminum Co. of America and others. **J. C. Holdgate** is assistant to the president and was formerly associated with Wean Engineering Co. as assistant chief engineer. **E. A. Matteson** is consulting engineer. He was associated with Aetna-Standard Engineering Co. for 19 years and is well known as a sheet and galvanizing consultant. He has received several patents for galvanizing, tinning and strip processing equipment. **A. W. Johnson, Jr.,** formerly assistant chief engineer, has been promoted to sales engineer and **John P. Walsh** from sales promotion to sales engineer.

Ervin L. Wentz, formerly superintendent of the U. S. Steel Co.'s open hearth department at Youngstown, Ohio, has been appointed division superintendent of steel production replacing **Edward E. McGinley,** who has been made division superintendent, steel production, at the company's Homestead, Pa., works in Pittsburgh, Pa. **Edgar R. Holstein,** who was superintendent of the bessemer department, has been transferred to the open hearth department as superintendent and **John D. Sutherland** has been named to succeed him as head of the bessemer operations. **Edmund J. Brandon,** formerly turn foreman in the open hearth department, will replace Mr. Sutherland as general foreman.

A. S. Blodget, Jr. was named manager of the Pittsburgh, Pa., district for Air Reduction Sales Co. **E. S. Twining, Jr.,** formerly assistant sales manager of the company's Philadelphia, Pa., district, succeeds Mr. Blodget as manager of the Boston, Mass., district.

The changes were made following the death of **S. D. Edsall,** former manager of the Pittsburgh district.

Frank Christenson of Refractory & Insulation Corp., New York, N. Y., was recently elected president and chairman of the board of the Industrial Mineral Fiber Institute, formerly the Industrial Mineral Wool Institute, at its eleventh annual meeting at Melvin Village, N. H. During the last year, Mr. Christenson, executive vice president of his company, was treasurer of the association representing 18 manufacturers of industrial mineral fiber in the United States, Canada and abroad.

M. L. Snodgrass has joined Sargeant and Wilbur Inc., Pawtucket, R. I., in the capacity of sales manager of the heavy furnace division. Mr. Snodgrass is thoroughly familiar with this type of equipment, having been vice president of Gas Machinery Co. of Cleveland, Ohio. **T. E. Schroeder** has also become affiliated with Sargeant & Wilbur, Inc., as chief engineer of the heavy furnace division.

Beresford N. Clarke was named sales engineer in the New England territory for Surface Combustion Corp. Mr. Clarke will be engaged in the sale of special furnace heat treat equipment, and will maintain headquarters in the Quincy, Mass., office.

Obituaries

Frank P. Townsend, a past-president of the Association of Iron and Steel Engineers (1910), died suddenly

FRANK P. TOWNSEND

on September 18. Mr. Townsend had been serving as development engineer for Copperweld Steel Company, Glassport, Pa.

Paul B. Greenawald, 58, vice president in charge of production and a director of Carpenter Steel Co., Reading, Pa., died September 4.

Stanley D. Edsall, Pittsburgh, Pa., district sales manager for the Air Reduction Sales Co., died recently in Pittsburgh. Mr. Edsall had been associated with the company since 1922.

Joseph M. Flood, 74, retired superintendent of tube mills, Youngstown Sheet and Tube Co., Youngstown, Ohio, died recently.

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When a high speed producing unit stops unexpectedly identify the fault point instantaneously. It will appear on the

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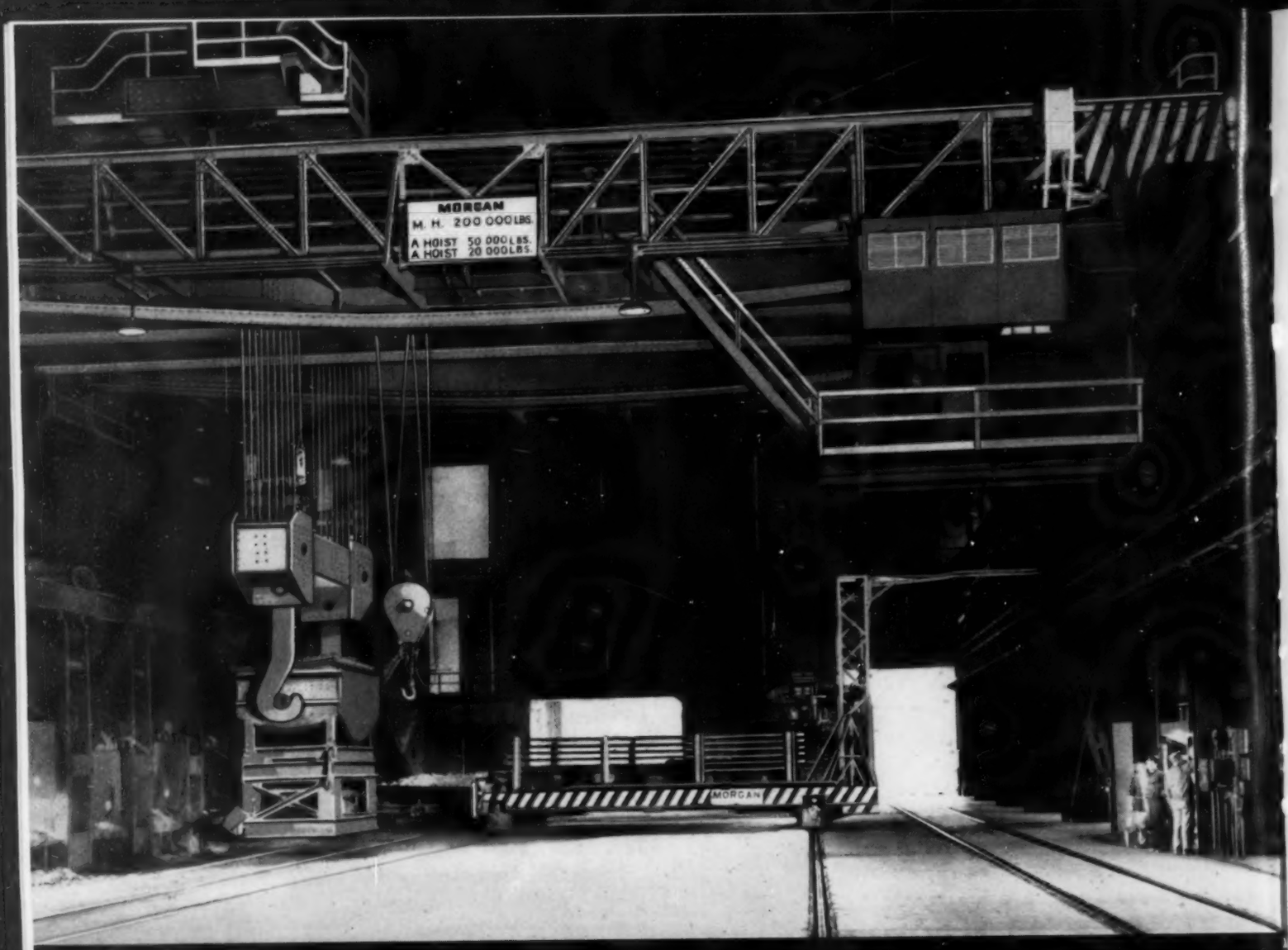

Illustrated is a 100-ton, 80'-0" span, 4-girder type Ladle Crane and a 7½-ton, 26'-0" span Floor Charger.

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Morgan equipment is built to last a long time as Morgan engineers rely upon a highly skilled shop organization, modern equipment, and progressive ideas in building Morgan steel mill machinery.

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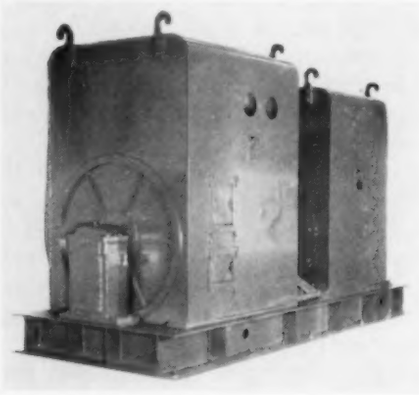
Equipment News...

ELECTRIC STIRRER

▲ Underneath the bottom of the new electric furnace recently built by American Bridge Co. and placed in operation by Timken Roller Bearing Co. is this electric winding which sets up a moving magnetic field inducing the stirring action of the molten metal within the furnace.



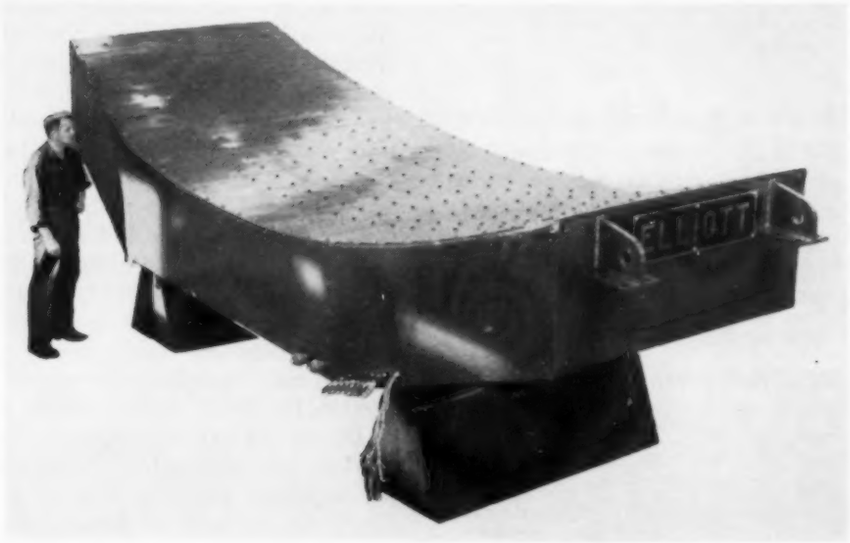
Power is supplied by an Elliott motor-generator set.

Known as an induction stirrer, this new electrical innovation was built by the Elliott Co.'s Ridgway Division for the Aros Electric, Inc., New York, N. Y., subsidiary of ASEA of Sweden.

With the new electric stirrer, a magnetic field is set up by electromagnets under the bottom of the furnace. The magnetic field, moving throughout the molten steel in the furnace, thoroughly mixes the heat of steel. Advantages of the new stirrer are three-fold: (1) it saves time and increases output; (2) it improves the quality and cleanliness of the steel; (3) it improves the slagging conditions of the heat, making reliable temperature control, and rapid sampling possible.

The coils of the stirrer are wound from hollow copper conductors, through which distilled water is circulated. A water-to-water heat exchanger extracts the heat from the recirculated distilled water. The winding is similar to a section of the winding of a normal a-c motor stator and consists of two poles wound for 2-phase current.

This unit for the electric stirrer is shown in the Elliot Co., Ridgway plant before shipment.



BRUSHING UNIT

▲ Improvements in the methods of using and handling power brushes are being developed by Osborn Manufacturing Co.

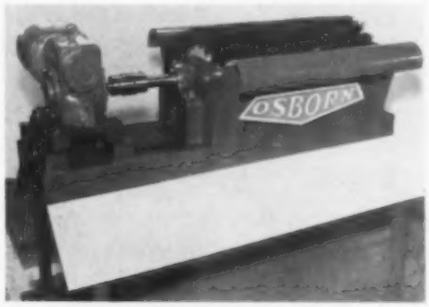
The full utilization of the potentials of power brushing has never been attained, largely because the development of machines which use brushes has not kept pace with the development of the brush and brush using opportunities. Because of their concern over the proper handling and use of their products, The Osborn Technical Department is developing a series of Brush Assembly Units that can easily fit into brush using machines that have many applications in industry.

An outstanding example of this new concept is a brushing unit designed for cleaning conveyor belts.

There are thousands of miles of conveyor belts in industrial plants in this nation that should be kept clean and free of the load material they carry such as coal, rubber, granular loads, etc.

The load material builds up on the conveyor belt and acts to cut down on operating efficiency by wearing on the belt, by transferring to the return rolls residue which acts as an abrasive on the belt and reverse flexes the belt. In addition, the residue which builds up is dangerous to both workers and machinery.

Existing industry practice is to periodically shut down the belt to be cleaned and clean it by hand. To clean the distance under the belt where

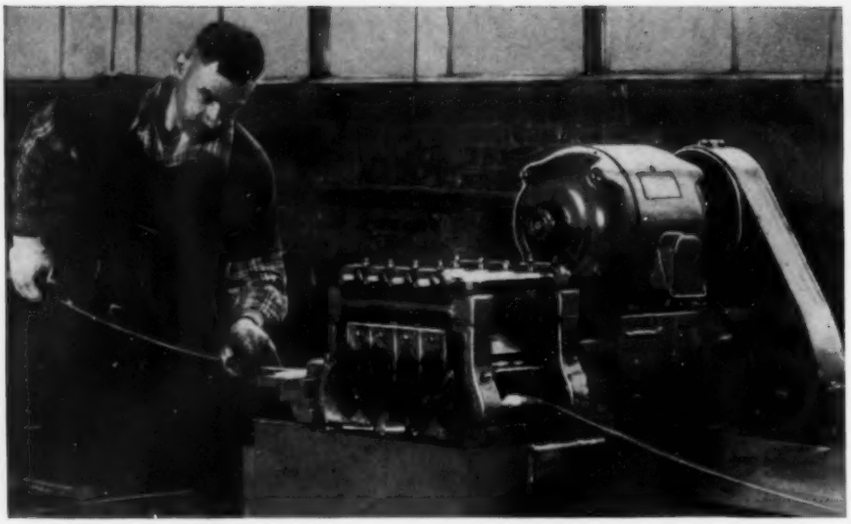


accumulation builds up involves costly machinery downtime and special maintenance work.

Several years ago, Osborn developed improved brushes to keep a conveyor continuously clean rather than let it load up and therefore have to periodically shut down for hand cleaning. This method is successful because the brush removed the material before it had a chance to become hard or embedded into the belt, or distributed as litter under the belt.

While developing the brush was a big contribution toward solving this problem, Osborn found that many plants did not have the necessary experience or equipment to build the brush driving and supporting equipment.

Finding this a basic need, Osborn has designed assembly units which will do the entire job and thus insure proper operation of the brush so that the required results would be obtained.



DOLAN STEEL flattens a wide range of materials and sizes with their TORRINGTON 9-ROLL FLATTENER

Designed to remove the buckles and waves from slab, strip and sheet metal, producing it commercially flat, Torrington Flatteners are made in a wide range of sizes, for ferrous or non-ferrous metals. The model shown above, in Dolan Steel Company's Bridgeport warehouse, handles mild steel in gauges from .050" to .187". All Torrington Flatteners have the built-in features that mean accurate, dependable performance over a long life of grueling service.

CHECK THESE SUPERIOR FEATURES:

1. All rolls are of alloy steel, hardened and ground, with large necks and bearings. All rolls are driven by spindles or universal joints; drive pinions are in oil-tight castings.
2. Top rolls have parallel individual adjustment; roll housings are of capped type, for easy roll removal.
3. Welded steel base is entirely self-contained; motor is mounted overhead to conserve floor space.
4. All gearing is totally enclosed and runs in oil; all moving parts are amply guarded for operator protection.
5. Built to the precision standards for which Torrington machines have been famous throughout American industry for over 65 years.

Torrington's decades of experience and knowledge, gained from continuous collaboration with foremost makers and fabricators of metal, are at your service to help you put Torrington Flatteners — or any other Torrington special-purpose machinery — to profitable use in your plant.

Call or write Torrington for information and name of nearest Torrington representative.

The TORRINGTON

MANUFACTURING COMPANY • TORRINGTON, CONNECTICUT

DESIGNERS AND BUILDERS OF MILL MACHINERY FOR SIXTY-FIVE YEARS

This conveyor cleaning unit consists of a special 12-inch diameter brush mounted in suitable bearings and coupled to a gear head motor, which is built on a channel base with an opening under the brush so that the material cleaned from the conveyor may be carried away for reclamation. Special guards guide the brushed off material into the channels.

The motor driving the brush may be coupled into the belt drive so that the brush stops when the belt stops.

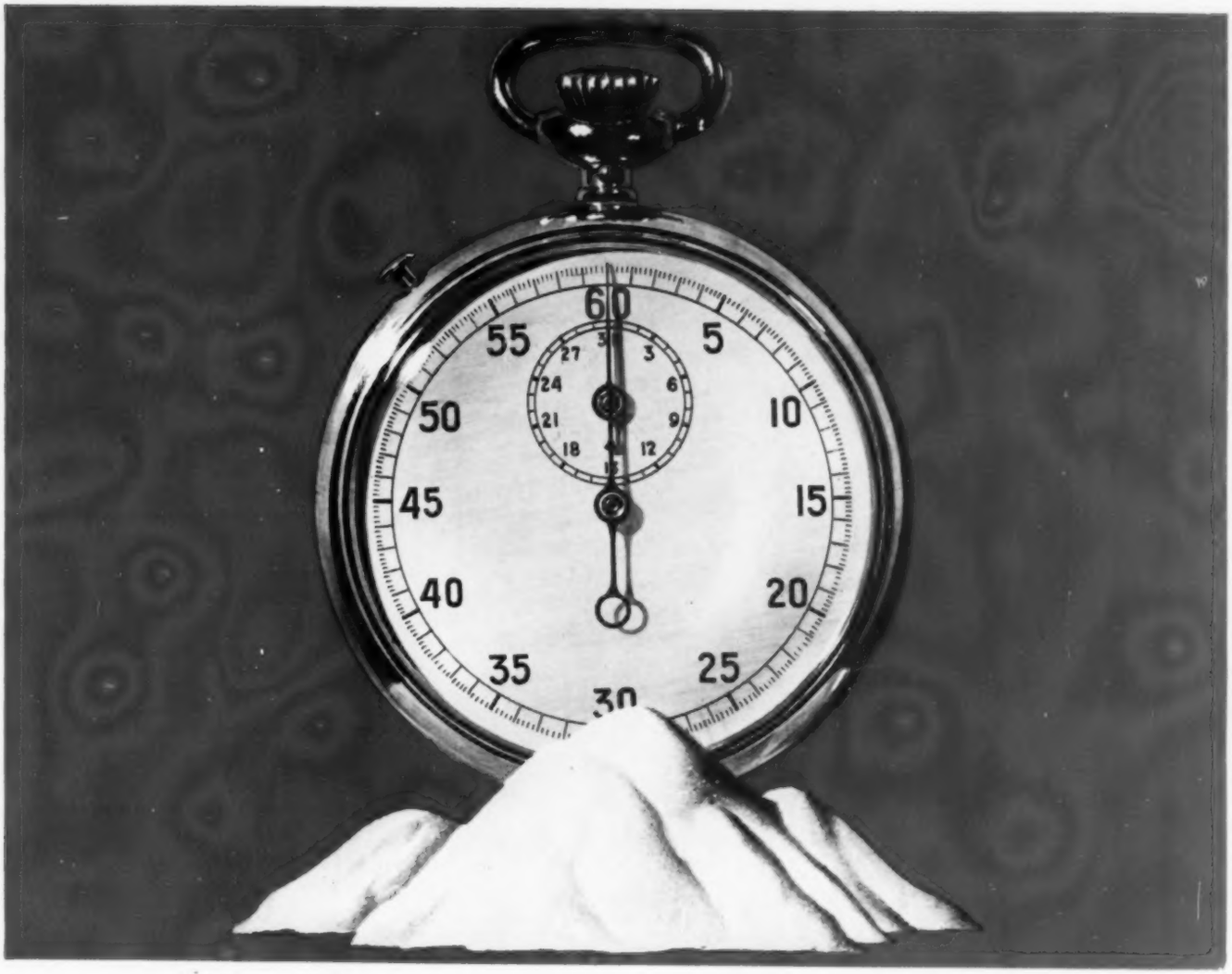
With such a unit, the user has only to fasten it into place, with proper adjusting means, and plug it into a power source. There are no bearings to mount in-line, no alignment of sheaves, belts, etc. All these details are taken care of in this package unit now available.

Because of their concern over the proper handling of their larger size power brushes, Osborn's technical department is also developing a line of special brush assembly units for quick and accurate insertion into place and removal from a brushing machine.

The purpose of this unit is to protect the brush against the hazards of possible damage and to facilitate handling larger size brushes. The unit is a complete brushing package equipped with brushes, bearings, guards, guides, and servicing adjustments.

These heavier duty brushes are mounted on a tubular core having sturdy shaft parts extending from either end. There are two pillow block bearings engaging one shaft end and a single pillow block bearing engaging the other shaft end. The latter is the longer one and carries a keyway designed to engage the driving means. When servicing the unit, to replace the brush part for example, the double bearing end need not be disturbed. After the brush unit has been removed from its position in a machine, and therefore detached from the driving means, the single pillow block bearing may easily be loosened from its base. That permits that end of the brush and the loosened bearing block to be lifted from the box guard mounting, and be swung upward about a pivot near the double pillow block bearings. This arrangement facilitates servicing of the brushes.

The unit weighs approximately 1600 lb, the brush alone weighing 600 lb. For operations requiring wider face brushes, heavier brush assembly units are required. The handling of such heavy weights without damage to the



How to speed your hot repairs!

You can cut excessive down-time for electric or open hearth bottom repairs when you use dependable Permanente 84 *periclase* ramming and patching mix.

Because patented Permanente 84 is easy to use, faster hot repairs are possible. And because Permanente 84 gives superior bottom performance, fewer repairs are required between heats.

Processed from high-purity periclase derived from sea water magnesia, Permanente 84 provides an unbeatable combination of high refractoriness and chemical resistance. Its high density and chemical purity minimize penetration of slag and metals.

It will pay you to specify Permanente 84 for open hearth and electric furnace rebuilds as well as for bottom, bank and tap hole maintenance.

Your Kaiser refractory engineer will give prompt attention to your refractory problem—will offer, where desired, research, design and installation service to give you maximum production most economically. Write for descriptive literature on Permanente 84 and the companion ramming mix, Permanente 165. Principal sales offices: *Chemical Division*, Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California. First National Tower, Akron, Ohio.

Kaiser Chemicals

Pioneers in Modern Basic Refractories

Basic Refractory Brick and Ramming Materials • Dolomite • Magnesia • Magnesite • Alumina • Periclase

how do your materials handling methods *Measure Up?*

An inventory of your materials handling methods might be profitable to you today. Are your methods of getting materials through production processes really modern methods? Are you getting finished products to storage or shipping via the best and most economical way? In other words, has your materials handling kept pace as you have grown and expanded your production?

A **little time** invested in a close look at your handling methods might save you **many dollars.** Possibly, being so close to your own everyday problems, you have overlooked some things that could be improved. Look over your operations again . . . and, if you see room for possible improvement, call in your nearby Mathews' Engineer. He'd like to help you to get better and more economical materials handling.

MATHEWS CONVEYERS

GENERAL OFFICES . . . . . *Mathews Conveyer Company*
ELLWOOD CITY, PENNSYLVANIA

PACIFIC COAST DIVISION . . *Mathews Conveyer Company West Coast*
SAN CARLOS, CALIFORNIA

CANADIAN DIVISION . . . . . *Mathews Conveyer Company, Ltd.*
PORT HOPE, ONTARIO

well trimmed working face of the brush is easily accomplished since holes in the box guard mounting can be used for hoisting.

The big brush and its mounting are dynamically balanced by means of special balancing collars.

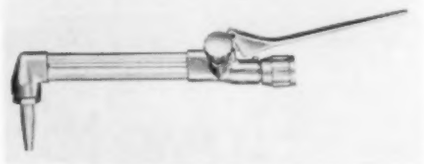
Brushes such as this are used for cleaning and scrubbing metal sheet or strip, cleaning conveyor belts, etc.

CUTTING ATTACHMENT

▲ A new cutting attachment that fits on either of two "Prest-O-Weld" welding blowpipes, cuts steel and other metals up to 8 in. thick. This is 2 to 4 times the thickness that previous models could cut.

The large increase in cutting range of the new attachment is achieved without a corresponding increase in operating pressures. Due to new design features, which include a large-diameter oxygen delivery tube and an improved mixer, only 55 psi oxygen pressure is needed to cut 4 in. of steel, and 100 psi will cut 8 in. of steel.

The new Type CW-122 cutting attachment was developed by Linde Air Products Co., a division of Union Carbide and Carbon Corp. It connects to the W-121 and W-122 welding blowpipes as quickly and easily



New general-duty cutting attachment — Type CW-122 — easily cuts up to 8 in. of steel.

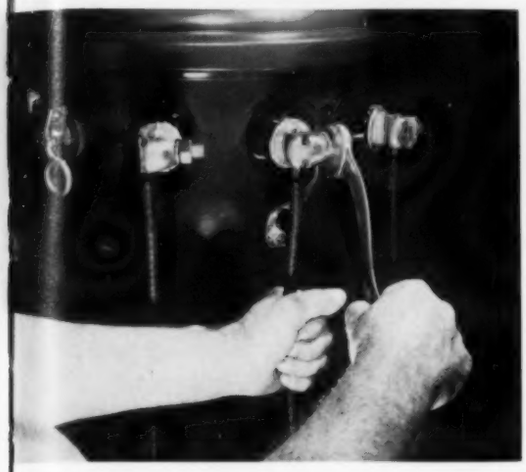
as a welding head. A hand-tightening connection nut locks attachment to handle. No wrench is needed.

A large selection of precisely fabricated cutting nozzles gives a wide range of usefulness to the CW-122, and assures smooth, efficient cuts on any work within its range. Twenty-three nozzles are available for general-purpose cutting, groove-cutting, and many other special jobs.

BALANCE DETECTOR

▲ An electronic detecting device that will markedly improve measurement of molten steel temperatures, an essential step in predetermining the quality of steel, was demonstrated recently at the Iron and Steel Exposition in the Public Auditorium, Cleveland.

NON-CORROSIVE ALLOY



A transformer terminal eyebolt, made of the new high-strength and non-corrosive alloy — Strenicor, is shown being tightened by a workman of the General Electric Co.'s distribution transformer department.

Composed of copper, nickel, silicon, and a small amount of iron, the new alloy is not susceptible to stress corrosion or season cracking when clamped to any tension within the ultimate strength of the material. When made by sand casting, the alloy has a tensile strength of 90,000 psi and a yield strength of 70,000 lb, while by hot forging it has a tensile strength of 107,000 psi and a yield strength of 83,000 lb.

Strenicor was developed by General Electric in co-operation with Revere Copper and Brass, Inc.

The new device, developed by engineers of Minneapolis-Honeywell's industrial division, uses fast-acting immersion thermocouples. In field tests in a half dozen steel mills the method has brought reductions in the cost of the temperature-taking operation as well as greater accuracy of the measurements. In one mill the cost for each temperature reading the conventional way was five dollars; utilization of the new device dropped the cost to 20 cents.

The instrument, called a "balance detector," extends the life of the immersion thermocouple assembly (the unit which is repeatedly thrust into the molten steel) by as much as 100 per cent. This is done, M-H engineers explained, by holding to an absolute minimum the time the unit is immersed in the hot steel. In addition, its increased sensitivity has speeded up the entire temperature reading operation, reducing the reading time by some 75 per cent in many instances.

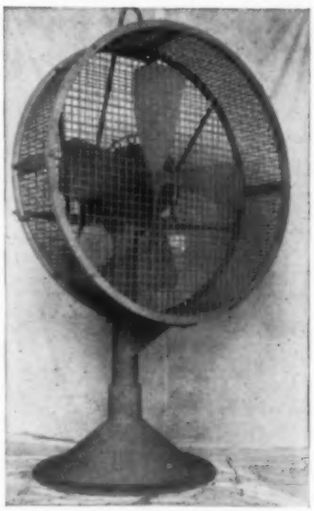
The instrument, when immersed in the molten steel, signals the operator at the precise moment the maximum, or true reading is obtained. Previously operators had to guess at this and consequently tended to leave the unit immersed in the steel too long. This usually resulted in outright disintegration of the expensive platinum thermocouple and was one of the big drawbacks for universal adoption of the immersion thermocouple technique for steel temperature measurement.

To illustrate how little margin there is for human error in this important steel production stage, the engineers explained that to measure the temperature of open hearth, low carbon steel at 2850 F, without the new electronic device, might take as long as 22 seconds. But if the operator misjudges by as much as 3 seconds, leaving the thermocouple in for 25 seconds, it will be destroyed. With the balance detector, they said, a proper reading can be obtained in precisely 10 sec-

IS HEAT SLOWING UP YOUR WORKMEN?

TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep them COOL with TRUFLO FANS



TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY
245 MAIN ST., HARMONY, PA.

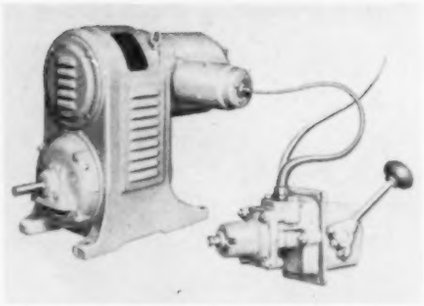
onds with no danger of ruining the expensive platinum unit.

PNEUMATIC CONTROL UNIT

▲ Variations in speed of U. S. "Varidrive" motors by pneumatic remote control are now possible through a recent development of U. S. Electrical Motors, Inc. This control consists of a positioning unit — an air operated plunger attached to the "Varidrive" speed changing device and an air valve which remotely controls the positioning unit. Four types of valves are available depending upon the method desired to operate the mechanism — pedal, lever, cam or wheel. The positioning units are designed to operate with an air pressure of either 60 or 100 psi.

Through the use of check valves and control station selectors in the system, the speed can be changed from any number of control stations. Conversely, any number may be controlled by one station providing they are to operate at the same speeds.

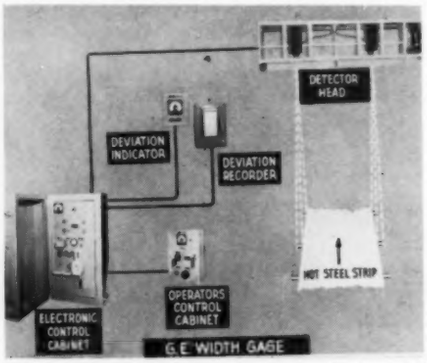
If desired, the pneumatic control may be used to provide speed changes from one pre-set finite speed to another by one quick movement, allowing the minimum amount of time and effort on the part of the operator.



STEEL WIDTH GAUGE

▲ A new non-contacting device which continuously and automatically measures the width of hot strip steel to an accuracy of plus-or-minus ⅛ in. has been announced by the General Electric Co.'s special products section.

Called the steel mill width gage, it is the first equipment of its kind ever developed, according to G-E engineers, and is expected to become one of the basic tools of the industry.



Diagrammatic view of new steel mill width gage. The new non-contacting device continuously and automatically measures the width of hot strip steel to an accuracy of plus-or-minus ⅛ in. Capable of measuring strip steel widths from 10 to 96 in., it is expected to become one of the basic tools in the steel industry, according to G-E engineers.

The width gage consists of a detector head, an operator's cabinet, and an electronic cabinet. Two phototube scanners are located in the gasket-sealed detector head mounted fifteen feet above the hot strip steel. They pick up the light radiated from the strip and convert it into electrical signals. The resulting signals are two

SAVE TIME

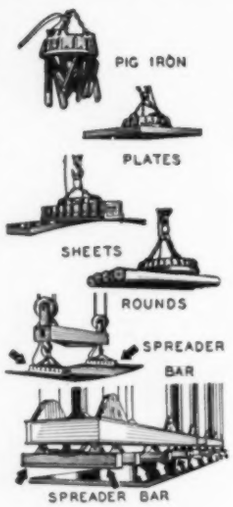
You can cut down the time for loading, unloading and moving hard to handle materials . . . and make a direct saving of hand labor. Whatever your job, STEARNS Lifting Magnets will help you save time and money.

Stearns LIFTING MAGNETS

STEARNS Lifting Magnets are being successfully and profitably used in handling scrap iron, steel plates, coils, bundles, strip steel, rails, slabs, billets, pig iron, castings, borings, turnings as well as finished products. The problem of loading or unloading . . . or moving large quantities of material quickly at a low cost — easily solved with STEARNS Lifting Magnets.

For the efficient handling of flat steel sheets, plates and regularly shaped steel bars and structural steel sections, be sure to investigate STEARNS Rectangular Lifting Magnets.

STEARNS Lifting Magnets pay for themselves in a short time, require surprisingly little attention, and are your best bet for economical, fast and safe moving of material.



Standard sizes available in both bolted and all welded constructions. Special sizes and shapes made to your requirements.

Foremost in the Magnetic Field

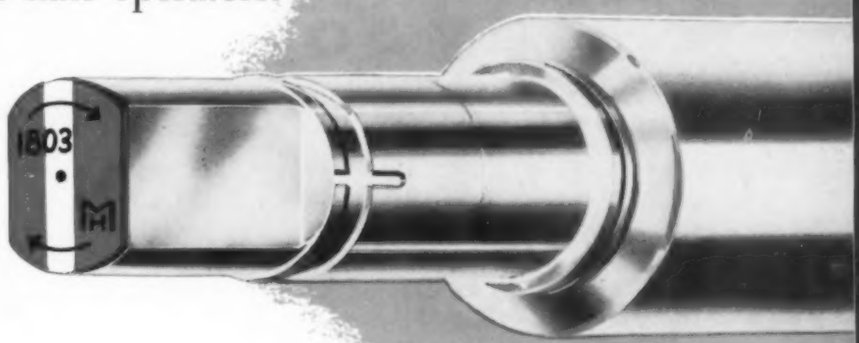
Stearns MAGNETIC INC.

681 South 28th Street • Milwaukee 46, Wisconsin

to modern hot strip rolling...

MACK-HEMP ROLLS *with the striped red wabblers* do a consistent job for the skilled hot strip mill operators who use them, because Mack-Hemp's engineers coordinate their roll research and development program with the demands of the mill operators.

As a result of this progressive policy, Mack-Hemp rolls *with the striped red wabblers* give a plus value to mill operations.



Because Mack-Hemp is always working to make each roll better than the one before—because Mack-Hemp keeps up with the latest developments in rolling mill practice, it's a good idea to keep your eye on what's new and different at Mack-Hemp.

MACKINTOSH-HEMPHILL
COMPANY
Makers of the Rolls with the Striped Red Wabblers
PITTSBURGH AND MIDLAND, PA.

MACKINTOSH-HEMPHILL PRODUCTS INCLUDE: rolls . . . steel and special alloy castings . . . completely integrated strip mills . . . heavy duty engine lathes . . . Mackintosh-Hemphill rotary straighteners . . . improved Johnston patented corrugated cinder pots and slag-handling equipment . . . shape straighteners . . . end-thrust bearings . . . shears . . . levellers

Look for the Mack-Hemp Rotary Straightener at the A. Milne & Co. Exhibit, Metal Show Philadelphia, week of October 20, 1952

pulsating square-waves. The square waves are each amplified, added together, and balanced against a standard voltage so that the difference produces a signal proportional to the width deviation.

The operator's cabinet contains a three-digit mechanical counter which indicates the width for which the gage is set, a deviation indicator, and the necessary controls and switches for setting basic width and making occasional calibration checks. In use, the operator sets the width indicator on the control panel to the width being run, and the detectors are automatically positioned over the strip edges by a motor-driven lead screw. The electronic cabinet contains a deviation indicator plus the majority of the electronic components of the gage. Optional equipment includes extra deviation indicators plus a deviation recorder for remote mounting.

Strip width of 10 to 96 in. can be measured at temperatures of 1350 to 2050 F and indicated in less than one second after the strip passes under the detector head. Strip position can change as much as three inches either vertically or horizontally without affecting the gage accuracy.

The height of the detector head over the strip keeps it away from scale, severe heat, corrosive fumes, and strip cobbles. No changes to the mill or mill table are required.

Power requirements are 550 volt-amperes, 220/440/550 volts, three phase 60 cycle.

TWIN DRIVE MOTORS

▲ The new 46-in. slabbing-blooming mill at the South Side plant, Pittsburgh, Pa., Works of the Jones & Laughlin Steel Corp. was engineered to break records.

To assure fast reversals of the 10,000 hp, 40/100 rpm main twin drive motor, the "Rototrol" regulators and the main machine exciters are designed to give high forcing voltages. The resulting time for a reversal from base speed to base speed with the mill connected, as shown on the oscillogram, is only one second.

The mill auxiliary equipment is also built for fast response and high production. The screwdowns, manipulators, mill tables, feed rolls, and ingot buggies are all driven from variable voltage systems. Each drive is fed from a "Rototrol" excited generator, that has a shovel characteristic, which gives fast flexible operation along with protection of the electrical and mechanical equipment during jamming, acceleration, and deceleration.

During the first few weeks of operation the customer found it necessary to slow down all of the variable voltage auxiliary drives. As the operators become more familiar with the new equipment, the speeds will be increased to take full advantage of the fast operation.

The variable voltage auxiliary control is arranged so that when any one of the 12 generators is out of service, an emergency generator will feed the particular drive and will automatically be controlled in accordance with the kw rating of the generator which it replaces.

The flywheel m-g set and the main drive control are arranged so that one of the four 2500 kw generators can be removed from the set for maintenance and the mill can be operated on the three remaining generators with little or no reduction in rolling capacity.

(*Continued on page 204*)

The Bailey

CINDER NOTCH STOPPER

for Safe, SURE CLOSING

- Absolute safety while inserting or withdrawing
- Adaptable to any cinder notch
- Same mechanism inserts and removes botter
- True alignment with cinder notch at all times
- Water-cooled cinder bott and rod
- Botter rod when withdrawn is well above trough

No workman need enter the danger zone to close blast furnace cinder notches, since all controls of this service-proved device are located in a remote position. Using a unique gravity action for inserting the bott in the monkey, it employs air or steam power action only for withdrawal.

In operation, an air or steam powered cylinder withdraws stopper to the "out" position, with a latch locking the bott rod in position during the flush. A tag line is used to release the latch, with gravity action immediately inserting the bott in the monkey. For over 20 years the Bailey Cinder Notch Stopper has been known for dependability and safety throughout the steel industry.

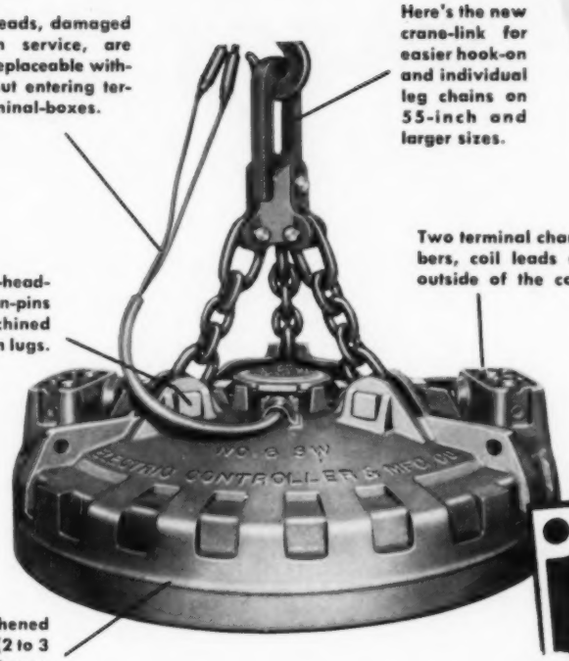
WILLIAM M. Bailey COMPANY

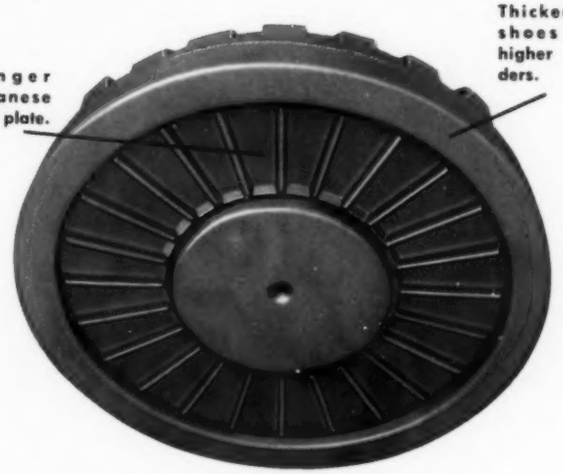
ENGINEERS

LEADERSHIP THROUGH QUALITY

1221 BANKSVILLE ROAD PITTSBURGH 16, PA.

BETTER and FASTER LIFTING with *Improved-Design*


Leads, damaged in service, are replaceable without entering terminal-boxes.
Here's the new crane-link for easier hook-on and individual leg chains on 55-inch and larger sizes.
Two terminal chambers, coil leads on outside of the coil.
Square-headed chain-pins in machined holes in lugs.
Strengthened welds (2 to 3 times stronger).
TYPE SW All-Welded LIFTING MAGNET
SIZE
SER.
FOL.
PERCENT TIME ON



EC&M developed the *All-Welded* lifting magnet, which by eliminating pole shoe bolt recessions, gave a better proportion of coil space. Now, new insulating materials are used for further improvement of the coil. Between turns, new purer asbestos tape is thinner because of its improved quality; and impregnated with EC&M 281 liquid to increase its mechanical strength. For use between layers, EC&M has developed ECAMICA Board having high dielectric strength and excellent mechanical durability. ECAMICA Board is far superior to any previous insulation used in lifting magnets.

ECAMICA Board—an EC&M development of major importance for insulation between coil-layers.

FOR COMPLETE FACTS, write for your copy of Bulletin 900 describing EC&M Type SW ALL-WELDED Lifting magnets.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

CONTINUOUS STRIP ANNEALING in DREVER

VERTICAL FURNACES

Saves Time • Reduces Cost

Outstanding PRODUCT

A Uniformly annealed strip from edge to edge and end to end of coil

B Uniform Physicals throughout the coil

C Clean, Lustrous Surface that electro-tins uniformly

D Stickers and "Dog Ears" eliminated

E Users of Continuous Annealed Strip report longer die and shear life

Drever Company has pioneered this striking improvement in Continuous Annealing Furnaces for Tin Plate Strip, Silicon Strip, Blue Plate and other strip products. We predict all major steel mills will anneal by this method. Why don't *you* do it now?

Equipment can be specified for output up to 30 tons per hour of 30″ wide x .010″ thick low carbon steel. Several sizes are available, in any width.

Furnace illustrated produces Tin Plate and Blue Plate. The shift-over from the Bright Surface required for Tin Plate to the uniformly applied, accurately controlled tight oxide coating required for blue plate is rapidly and easily made.

Installations backed by staff of Engineers and Metallurgists of sixteen years experience in Continuous Annealing of Low Carbon Strip.

Outstanding DESIGN

1 Speeds up to 1000 feet per minute

2 Controlled Strip Tension, excellent tracking

3 Controlled Heating and Soaking Time

4 Regulated Cooling Rate

5 Predictable Strip Temper

6 Cleaning in same line

7 Low Maintenance

8 Reduction in Floor Space

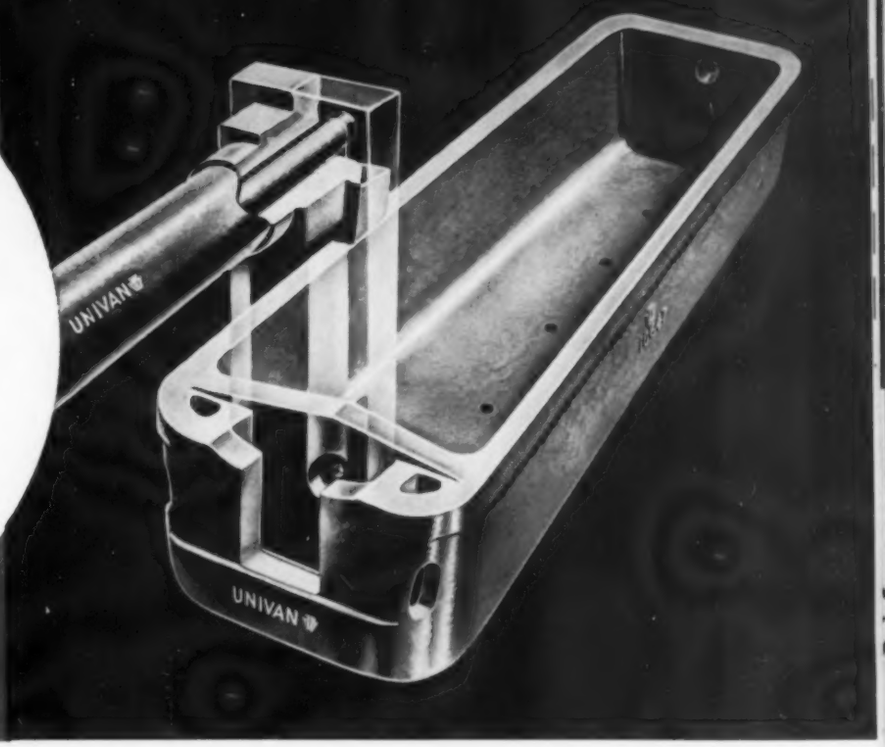
9 Reduction in Coil Inventory

10 Overall Saving in Annealing and Cleaning Costs

DREVER CO.
730 E. VENANGO ST.
PHILADELPHIA 34, PA.

Booth 1980 at the Metal Show

CHARGING BOXES
make mighty expensive SCRAP!



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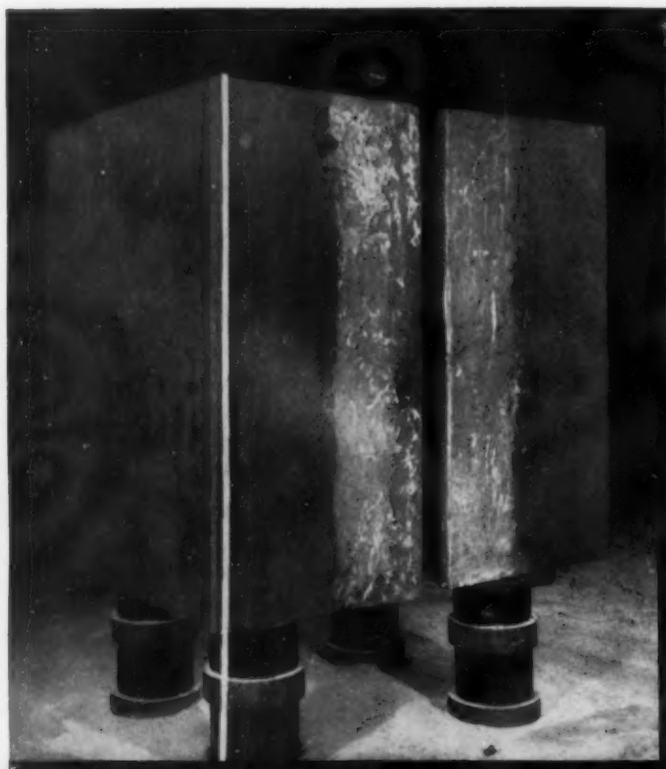

Fig. 1—Two forgings for ram in position prior to Thermit Welding.

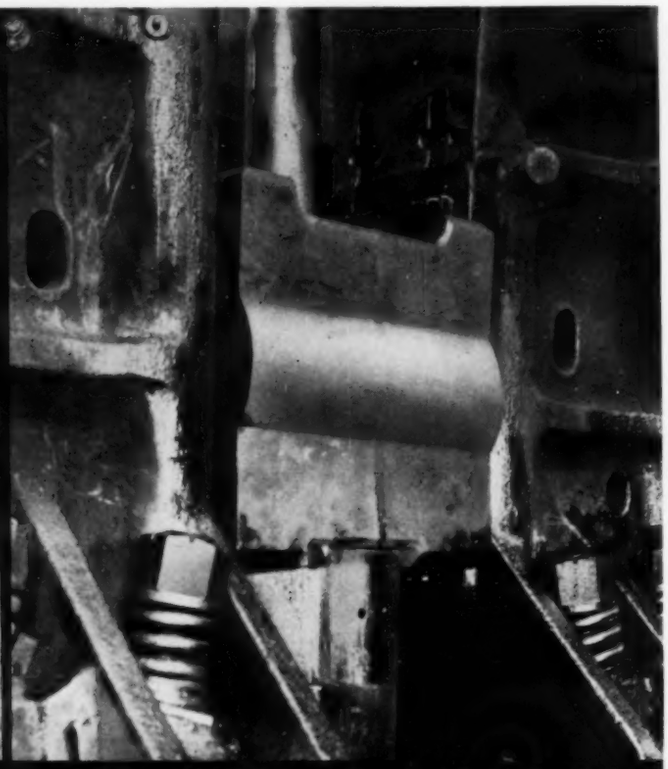

Fig. 2—Finished 35,000 lb. ram after fabrication by Thermit method.

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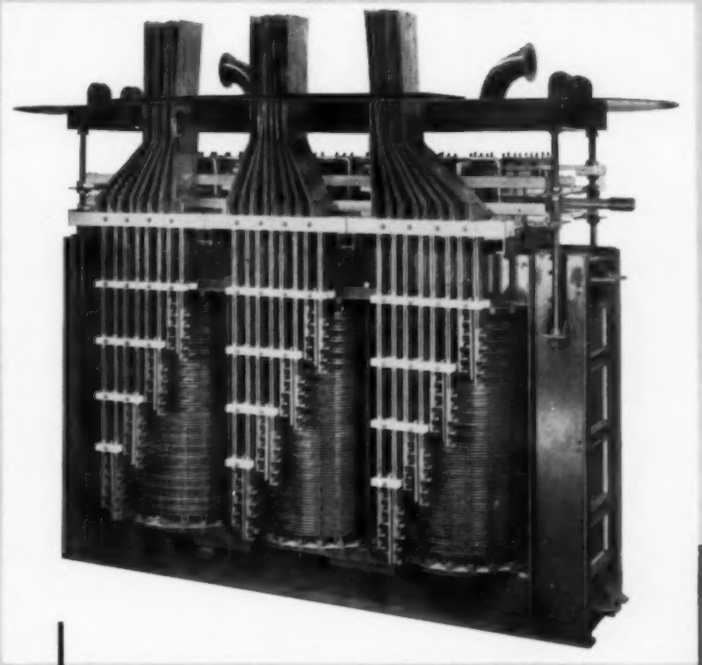

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Pennsylvania can build a Furnace Transformer for any size electric furnace

External view of transformer. Compartment on left houses motor-operated tap changer.

The successful operation of Pennsylvania Furnace Transformers and their industry-wide acceptance indicate that Pennsylvania engineers fully understand the application of furnace transformers to electric furnaces.

For example, in 1936 Pennsylvania introduced a new type of helical winding in the low voltage coils of a 2500 Kva furnace transformer. Since then, the same principles of coil design have been incorporated into Pennsylvania furnace transformers totaling over 1¼ million Kva. In all the intervening years, there has *never* been a low voltage winding breakdown on any of these furnace transformers.

Because its engineering is basically and fundamentally correct, Pennsylvania can build furnace transformers for any size electric furnace now being manufactured or being contemplated for future construction.

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Applicants should be between the ages of 25 and 30, have an engineering degree in Metallurgy, and have a practical knowledge of steel fabricating methods, including stainless steel. Send resume of background, together with salary requirements, to Personnel Manager.

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EQUIPMENT NEWS

(*Continued from page 196*)

In the near future three more Westinghouse twin drive mills will be in operation, two 12,000 hp universal slabbing mills and an 8000 hp blooming mill.

COLD STRIP MILL

▲ Rolling orders for cold strip stock of unusual width, gage, temper and finish poses no problems for Production Steel Coil Co., Inc., Detroit, Mich., which recently installed a 10 in. & 20 in. × 28 in. 4-high reversing cold strip mill.

The mill is one of the latest in a long list to be powered and controlled by electrical equipment designed and developed expressly for mill service by the Reliance Electric & Engineering Co., Cleveland, Ohio.

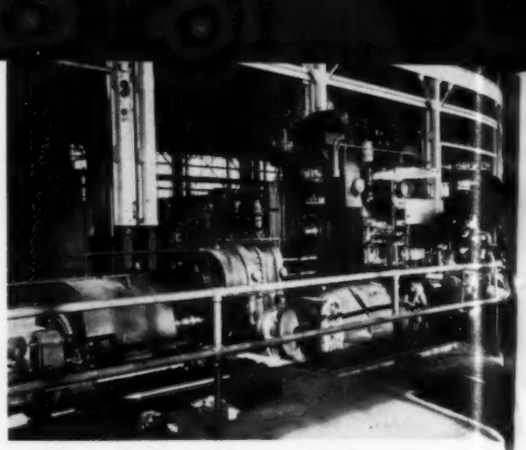
This 4-high reversing cold strip mill is powered by a 600-hp, 575/1150-rpm, 600-volt, d-c reversing, rolling mill type motor, backed by a 500-kw generator.

Special generator field design and control circuits are utilized to provide fast lineal acceleration and deceleration between zero and preset operating speed — an essential requisite for good reversing mill operation.

The reels are each powered by a 200-hp, 230-volt, d-c, 300/1200-rpm motor especially selected for low WR^2. Individual generators are supplied for each reel motor to provide for constant tension over the constant horsepower range of the mill motor and to accommodate a wide reduction range.

Four Reliance VSA rotating regulators are employed for the reels — two for reel generator voltage, and two for the reel motor field.

The reel generator regulators maintain generator voltage to a preset percentage of a pilot generator voltage, this pilot generator being driven by the mill motor.

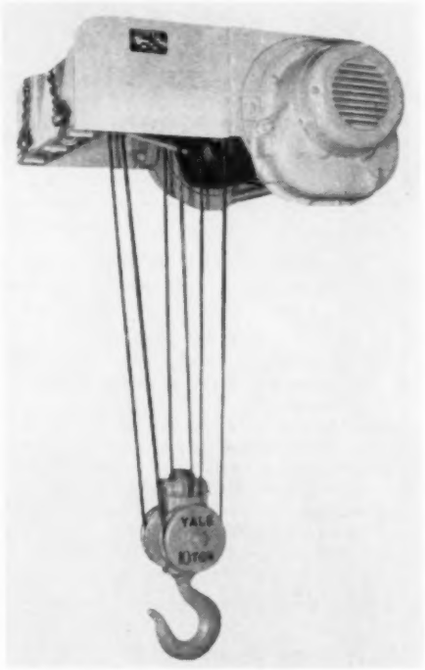


Shown are mill motors and tension reel motors of 4-high reversing cold strip mill recently installed.

Special reel motor field regulator circuits are utilized to provide for closed armature loop reversing transfer in addition to the normal automatic compensation for coil diameter variables.

ELECTRIC HOIST UNIT

▲ New deck-type "Cable King" electric hoists, designed for top mounting in double-girder bridge cranes, are available from Yale & Towne Manufacturing Co.



The units, available in capacities of from 1 to 15 tons, feature compactness of design; triple-reduction, spur-geared drive; totally-enclosed, fan-cooled motor; rugged heavy steel suspension frame; and pushbutton-operated heavy-duty contractor.

For safety, the hoists are equipped with two brakes — a Weston-type friction brake in the gear train, and a solenoid-operated contracting drum-type motor brake.

The control station can be mounted in the crane cab or remotely located.

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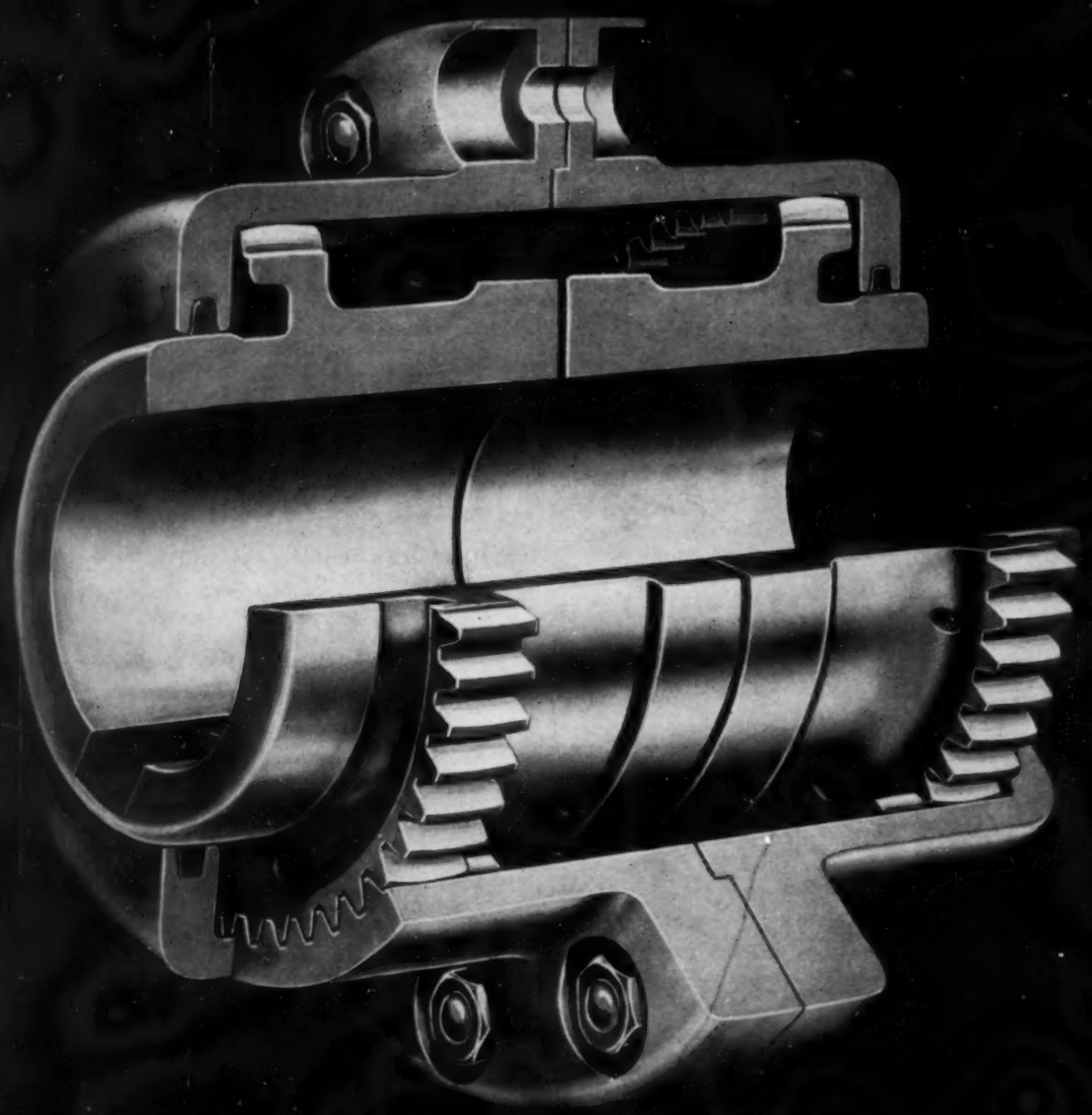
POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

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Worm gearing—universal in its application—affords advantages for almost every power transmission job. For worm and gears—in standard sets or special requirements—you can always depend on Cleveland.

Flue-dust fluffer has CLEVELAND drive

THIS tumbling barrel fluffer mixes ore-laden flue dust with water for sintering at an important steel mill. Since proper mixing of these ore fines affects the degree of sinter porosity, the fluffer must be powered by a smooth and dependable drive. To meet these requirements, the builder chose a Cleveland worm gear speed reducer.

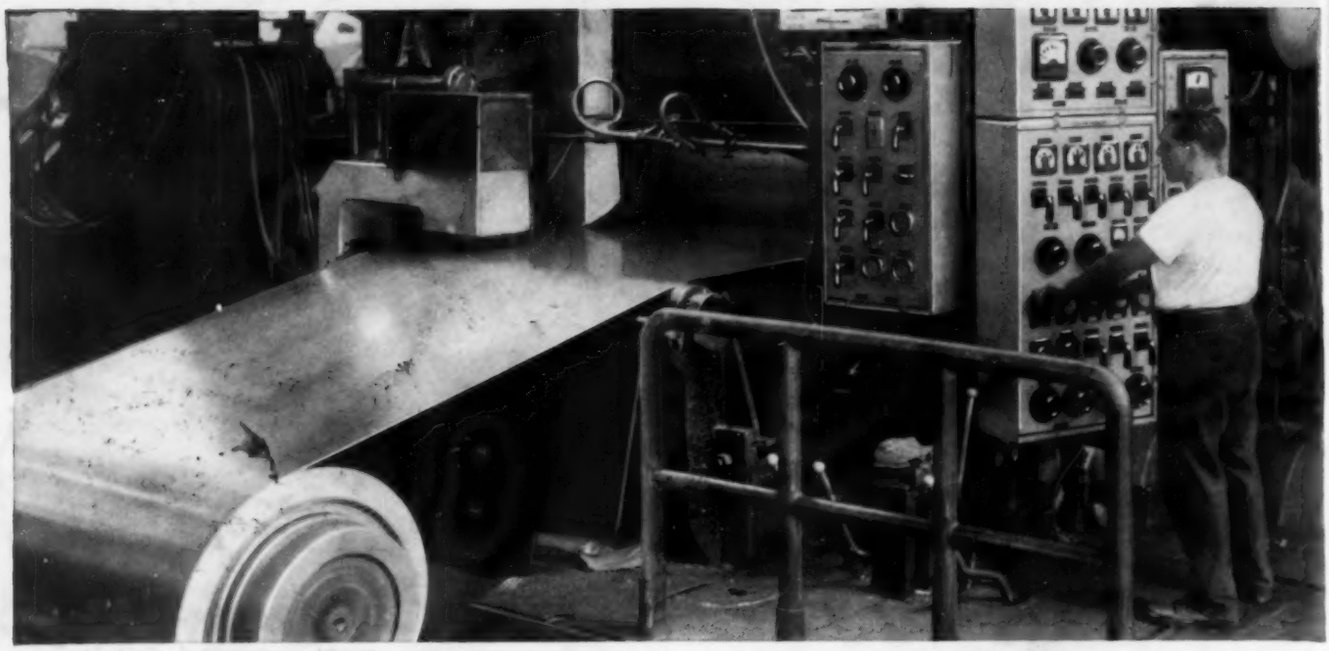
And no wonder! Cleveland drives have been job-proven for forty years in the steel, as well as in other supporting industries, such as the sintering plant above.

Day in, day out, you'll find Clevelands at work operating conveyors, picklers, mill cranes, compressors and other equipment—in fact, wherever a right angle drive is desired. For steel men know from experience that a safe and sure Cleveland never fluffs a job.

For full information on the complete Cleveland line, write now for new Catalog 400. The Cleveland Worm and Gear Company, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers



CONTINUOUS GAGING is provided by the non-contacting, 50-kv G-E X-Ray Thickness Gage installed on this 4-stand tandem sheet mill. Gage operates between last stand and an idler roller preceding winding reel.

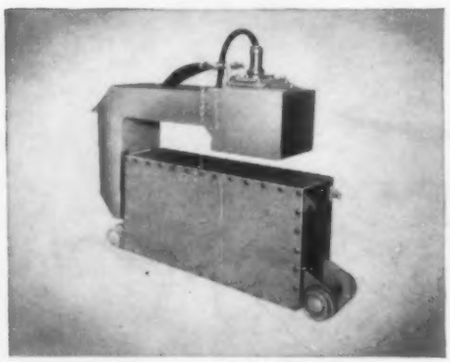
G-E X-Ray Thickness Gage cuts scrap losses, saves steel

Continuous, non-contacting gaging enables hot and cold mill operators to get on gage faster, roll to closer tolerances

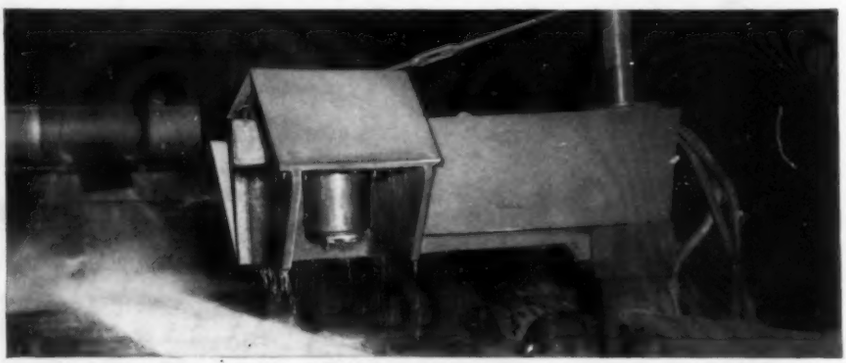
Now—with the General Electric X-Ray Gage—hot mill users can reach gage on the first slab, reduce re-rolls; cold mill users can get on gage faster, roll to closer tolerances.

Pioneered by General Electric, it is now used by most steel companies because it is accurate, dependable, and withstands severe rolling-mill conditions. In 50- and 100-kv ratings, it covers a range from as low as .005 inch for cold mills to as high as .400 inch for hot mills.

For more data, contact your G-E steel mill specialist or write for Bulletin GEA-5622 to General Electric Co., Section 687-100, Schenectady 5, N. Y.



FOR COLD MILLS, this 50-kv gage is mounted as one unit. Top arm contains detector located eight inches above bottom tank which contains x-ray tube and transformer.



FOR HOT MILLS gages like this 100-kv gage at Weirton Steel Company, Weirton, W. Va., measure the thickness of hot-strip steel at speeds exceeding 1700 fpm. Weirton operators say it enables them to reach gage on the first slab. Formerly four slabs could go through the mill before a report on gage was obtained.

GENERAL ELECTRIC